# Tennessee Consolidated Retirement System Experience Study

JULY 1, 2016 - JUNE 30, 2020

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The Honorable David H. Lillard, Jr., Chairman
Board of Trustees
Tennessee Consolidated Retirement System
Nashville, Tennessee 37219

Dear Mr. Lillard:

Submitted herewith are the results of an experience study of the Tennessee Consolidated Retirement System prepared for the four year period ending June 30, 2020, pursuant to the provisions of TCA Section 8-34-503(b). Also included are recommendations with respect to the actuarial assumptions of the plan for use with valuations occurring after this study date.

We trust that this report will be helpful in formulation of policy with respect to the operation and financing of the System. We very much appreciate the opportunity to serve the Board of Trustees, and will be pleased to supplement this report in any way, as you request.

The staff of the Tennessee Consolidated Retirement System has been extremely helpful and cooperative in developing the information required for this study. Their cooperation has been greatly appreciated, and is hereby acknowledged.

The study summarized in this report has been performed utilizing generally accepted actuarial principles and, where applicable, applying actuarial standards of practice. The undersigned is an actuary at USI Consulting Group, is a member of the American Academy of Actuaries, and has met the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions herein.

Respectfully submitted,

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Enclosures

# Contents

# Summary of Report

## Introduction

"At least once in each six (6) year period, the actuary shall make an actuarial investigation into the mortality, service and compensation experience of the members and beneficiaries of the retirement system, and taking into account the results of such investigation, the board of trustees shall adopt for the retirement system such mortality, service, and other tables as shall be deemed necessary."

Tennessee Code Annotated, Section 8-34-503(b)

Since the Tennessee Consolidated Retirement System was established effective July 1, 1972, an actuarial experience study has been conducted periodically in accordance with the statute cited above. Each study has covered a four year reporting period, in compliance with the statutory requirement prior to amendment in 1992 to permit a six year rather than four year span. The current study examines the four year period ending June 30, 2020.

The initial four year period ended June 30, 1976. The experience study performed as of that date reached some definite conclusions and identified other probable trends. However, there were shortcomings to the data collected for the study because the records on which the study drew had been established, necessarily, to support the ongoing administration of the System. Steps were taken at that time to begin accumulating more elaborate information so that studies performed as of June 30, 1980 and later produced more comprehensive results. The data collection process continues to be refined to take advantage of the additional processing power made available by advances in technology. Information that was not previously available is now gathered allowing more elaborate analysis of results.

TCA 8-34-503(b) provides that the periodic actuarial investigation shall cover the "mortality, service and compensation experience" of the System. Within this framework, the various factors relating to the System's experience can be categorized, as follows:

A. Demographic Assumptions
    1. Post-retirement Mortality
    2. Pre-retirement Mortality
    3. Rates of Disability
    4. Turnover (i.e., withdrawal from the System)
    5. Spreads of Retirement Age
B. Economic Assumptions
    1. Rate of Investment Return
    2. Changes in Compensation for Continuing Employees
    3. Increases in Social Security Taxable Wage Base
    4. Cost of Living Adjustments

Each of the factors is discussed separately in the following sections of this report.

# Summary of Report (Continued)

As input for the study, census data was obtained for the fiscal years beginning July 1, 2016, 2017, 2018, and 2019. For each year, the employee population established as of the beginning of the fiscal year was traced through the end of the fiscal year. For these years, records had been provided by TCRS indicating whether each individual was still a member of the System as of the end of the fiscal year or, if he was no longer a member, the cause of his withdrawal (retirement, disability, death, etc.).

Salaries were reported for each employee who was an active participant as of the beginning of each fiscal year. For each individual who remained an active employee as of the end of a fiscal year, salaries were compared to full year salaries reported in the previous fiscal year in order to determine compensation increase rates.

In studying each "decrement" (that is, each reason for which individuals could have withdrawn from the System), a comparison of "actual" to "expected" terminations was made. The number of "actual" withdrawals for each cause was tabulated from the records maintained by the System. The "expected" terminations for each cause were determined by applying the rates of decrement recommended with the 2016 experience study to the exposure (that is, the number of individuals active as of the beginning of each fiscal year). By comparing the ratio of actual terminations to expected terminations for each cause, the validity of the actuarial tables was tested.

Results for the four separate years included in the review period have been combined in order to increase the sample size and smooth out random variations.

Each of the studies investigated several groups separately, because it was felt that they might have significantly different experience. The groups were defined as follows:

1. Teachers
2. General State Employees
3. Employees of Political Subdivisions
4. "Group II" Members (Firemen, Police, Wildlife Officers, and Highway Patrol)
5. "Group III" Members (County officials and Public Service Commissioners)
6. UT-TIAA with Guarantees
7. Local Teachers in Closed Systems
8. "Aged" Teachers and State Employees (retired lives only)

In practice, "Group II" and "Group III" were small, closed groups which were not large enough to generate credible experience, and "UT-TIAA", local teachers, and "aged" retirees exhibited experience quite similar to the larger group of teachers. Therefore, primary attention was paid to the first three groups—Teachers, general State employees and employees of Political Subdivisions. The results shown for Teachers include not only contributory ("K-12") teachers, but UT-TIAA members and local teachers, as well as "aged" retirees. "Non-Contributory" teachers (higher education) are included with general State employees, since they are combined with them for purposes of determining contribution rates.

# Summary of Report (Continued)

Each of the sections in the Demographic Assumptions portion of the report deals with a particular rate of decrement or other assumption, in the order previously listed. For each assumption, the "ratios of actual to expected" based on the current tables are illustrated and discussed. A recommendation is then made concerning each assumption. The Board may choose to adopt the recommendations for use with valuations occurring after this study date and with any actuarial calculations required prior to subsequent changes in the assumptions.

## Effect of Actuarial Assumptions on Plan Costs

It is important to realize that actuarial assumptions do not determine the ultimate cost of a pension plan. Actual experience (benefits paid plus the expenses of plan operation, less interest earned on plan assets) ultimately determines the amount which the plan sponsor must contribute. What the actuarial assumptions do, in combination with the actuarial funding method, is determine the incidence of the plan's ultimate cost over a period of years --- how much the plan's sponsor must contribute to the plan each year.

For example, if a very "conservative" set of assumptions is used as the basis for a valuation (low interest earnings, high salary increases, low turnover, low mortality rates), the initial cost of the plan will be high, but the required contribution rates will in all likelihood decrease gradually in later years. If, on the other hand, a plan starts out using a very "liberal" or "optimistic" set of assumptions (high interest earnings, low salary increases, high turnover, high mortality rates), the initial cost of the plan may be quite low, but plan costs will gradually increase in future years.

For most employers, a fairly level plan contribution as a percentage of covered payroll is a desirable goal. Therefore, plan sponsors usually try to choose assumptions that they feel are generally reasonable. In the absence of unusual events, a reasonable set of actuarial assumptions can be expected to develop a reasonably level series of annual contributions.

The purpose of the experience study is to review the existing set of actuarial assumptions and identify any trends in participant behavior or economic situations that are deemed to be long-term in nature. Any changes to the assumptions would be expected to have an impact on the future level of required contributions to the plan.

# Demographic Assumptions

## General Approach

The portion of the study concerning active participants was based on the active life data associated with fiscal years beginning in 2016 through 2019. For each plan year, a record was established for each person who was an active participant in the plan as of the beginning of the year. Those records were tracked through the end of each fiscal year to determine the employment status at that time. A similar process was used to develop records concerning mortality among retired lives to determine whether the participant was still living at the end of the respective fiscal years.

These records served as the basis for the experience study. For most of the actuarial assumptions, the study took the form of determining ratios of "actual" results to the "expected" results obtained by applying the current tables to the participating lives. The table on the next page shows an example of the way in which "actual" terminations were compared to "expected" terminations and a ratio of "actual to expected" was obtained.

In order to obtain this table, each record was treated as a "unit of exposure" -- that is, the participant with which it is associated entered the year and was "exposed" to the contingency being measured. The member either terminated participation for this reason during the year or did not. In either event, it counted as a unit of exposure, so the exposure figure for the proper age and sex was increased by one. If the person actually terminated participation for this reason, the "actual" column was also increased by one for that age and sex; if the person was still employed at the end of the year, or if he terminated for some other reason, no entry was made to the "actual" column. An "expected" figure was calculated by multiplying the one unit of exposure by the probability of termination included in the turnover table currently being utilized in the valuation. For example, if for a particular age and sex the current table assumes that 15% of the participants will terminate employment during the next year, a factor of .15 was added to the "expected" column for the appropriate age and sex.

After all of the records were processed through the program, ratios of actual to expected were calculated. For example, over the four years of observation, 6,788 males between the ages of 31 and 35 began a year of employment. Of those 6,788 people, 571 terminated their employment before the end of the year. On the other hand, the turnover table currently being utilized assumes that approximately 6.82% of males in this age bracket will terminate their employment, so the "expected" figure was 463. Thus, actual terminations in this category were greater than the "expected" terminations --- the ratio of actual to expected was 123.41%. These results can be seen in the example table on the following page.

# Demographic Assumptions (Continued)

*General State*
*Ultimate Withdrawal*
*Unweighted*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 16-20 | 1 | 0 | 0 | n/a |
| | 21-25 | 1,060 | 172 | 165 | 104.20 |
| | 26-30 | 5,117 | 552 | 576 | 95.83 |
| | 31-35 | 6,788 | 571 | 463 | 123.41 |
| | 36-40 | 8,436 | 533 | 292 | 182.45 |
| | 41-45 | 8,884 | 425 | 176 | 241.84 |
| | 46-50 | 10,529 | 463 | 209 | 221.23 |
| | 51-55 | 9,232 | 388 | 218 | 177.79 |
| | 56-60 | 3,668 | 174 | 127 | 136.83 |
| | 61-65 | 192 | 14 | 7 | 193.77 |
| | 66-70 | 51 | 6 | 0 | n/a |
| | 71-75 | 19 | 4 | 0 | n/a |
| | TOTAL | 53,977 | 3,302 | 2,234 | 147.82 |
| **FEMALE** | 16-20 | 2 | 2 | 0 | n/a |
| | 21-25 | 823 | 136 | 126 | 107.86 |
| | 26-30 | 6,547 | 751 | 777 | 96.62 |
| | 31-35 | 9,482 | 834 | 736 | 113.28 |
| | 36-40 | 11,808 | 724 | 525 | 138.03 |
| | 41-45 | 13,710 | 626 | 356 | 175.71 |
| | 46-50 | 14,936 | 665 | 330 | 201.51 |
| | 51-55 | 14,434 | 673 | 423 | 159.05 |
| | 56-60 | 5,850 | 297 | 226 | 131.18 |
| | 61-65 | 142 | 21 | 7 | 299.77 |
| | 66-70 | 38 | 3 | 0 | n/a |
| | 71-75 | 8 | 0 | 0 | n/a |
| | TOTAL | 77,780 | 4,732 | 3,507 | 134.92 |
| **TOTAL** | 16-20 | 3 | 2 | 1 | 367.72 |
| | 21-25 | 1,883 | 308 | 291 | 105.79 |
| | 26-30 | 11,664 | 1,303 | 1,353 | 96.28 |
| | 31-35 | 16,270 | 1,405 | 1,199 | 117.19 |
| | 36-40 | 20,244 | 1,257 | 817 | 153.92 |
| | 41-45 | 22,594 | 1,051 | 532 | 197.56 |
| | 46-50 | 25,465 | 1,128 | 539 | 209.16 |
| | 51-55 | 23,666 | 1,061 | 641 | 165.42 |
| | 56-60 | 9,518 | 471 | 354 | 133.21 |
| | 61-65 | 334 | 35 | 14 | 245.95 |
| | 66-70 | 89 | 9 | 0 | n/a |
| | 71-75 | 27 | 4 | 0 | n/a |
| | TOTAL | 131,757 | 8,034 | 5,741 | 139.94 |

# Demographic Assumptions (Continued)

This example provides a simplified illustration of the methodology used in succeeding sections of the report. Actual comparisons made herein are conducted on the basis described above but have been modified by "weighting" in order to enhance the effectiveness of the results. The weighting process gives recognition to the fact that some participants, due to associated larger liabilities, have a greater impact on valuation results than others. For instance, a senior official who has completed a significant number of years of service and receives a high salary will have a substantially larger actuarial liability than a short service lower paid employee of the same age. The impact on the plan of service retirement of the senior official is a more significant event than retirement of the lower paid employee of the same age. Therefore, the "number" of participants used to develop exposure, actual and expected numbers has been weighted by multiplying the number by the actuarial liability for that participant. Actuarial assumptions recommended with the 2016 experience study are used in determining liability weightings. For instance, an employee with a liability of $10,000 for whom the probability of termination was 10% would result in exposure and expected amounts for a particular year of 1 and 0.10 respectively on an unweighted basis and 10,000 and 1,000 respectively on a weighted basis. If the participant died during the year, the "actual" weighted entry for the year would be 10,000.

The charts presented herein have been developed recognizing liability weightings. Weighted results have been reduced proportionately to maintain the displayed exposure amounts within a reasonable range.

The table on the following page shows the results of the earlier table after data for participants have been weighted by liability amount. After weighting, the actual to expected ratio for the group of Consolidated State male employees between 31 and 35 years of age is reduced from 123.41% to 92.49%. The reduction suggests that higher paid employees with relatively more seniority are less inclined to terminate employment than lower paid employees with shorter periods of service. This result is expected and is further confirmed by comparing the overall actual to expected ratio between the two tables. The overall ratio declines from 139.94% to 114.82%. The process of correlating rates of termination, death, etc. to liability weightings ensures that actuarial assumptions are developed in the same manner they are applied. Both the development of the rates in the experience study and their application in the valuation process are with respect to liability amounts.

# Demographic Assumptions (Continued)

*General State*
*Ultimate Withdrawal*
*Weighted*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 16-20 | 7 | 0 | 1 | 0.00 |
| | 21-25 | 10,912 | 1,569 | 1,679 | 93.49 |
| | 26-30 | 111,062 | 9,807 | 12,166 | 80.62 |
| | 31-35 | 287,303 | 17,594 | 19,023 | 92.49 |
| | 36-40 | 586,733 | 24,637 | 19,836 | 124.20 |
| | 41-45 | 888,407 | 26,224 | 17,447 | 150.30 |
| | 46-50 | 1,335,996 | 33,425 | 26,645 | 125.45 |
| | 51-55 | 1,149,191 | 33,469 | 27,093 | 123.53 |
| | 56-60 | 412,618 | 14,408 | 14,262 | 101.03 |
| | 61-65 | 10,763 | 208 | 435 | 47.77 |
| | 66-70 | 1,603 | 94 | 0 | n/a |
| | 71-75 | 177 | 25 | 0 | n/a |
| | TOTAL | 4,794,771 | 161,461 | 138,586 | 116.51 |
| **FEMALE** | 16-20 | 10 | 10 | 2 | 545.88 |
| | 21-25 | 7,659 | 1,131 | 1,166 | 96.94 |
| | 26-30 | 127,785 | 12,271 | 14,806 | 82.88 |
| | 31-35 | 372,605 | 26,522 | 28,203 | 94.04 |
| | 36-40 | 786,288 | 34,293 | 34,209 | 100.25 |
| | 41-45 | 1,227,217 | 39,230 | 31,682 | 123.82 |
| | 46-50 | 1,580,908 | 46,401 | 34,964 | 132.71 |
| | 51-55 | 1,620,936 | 58,018 | 47,536 | 122.05 |
| | 56-60 | 651,399 | 29,544 | 25,136 | 117.53 |
| | 61-65 | 5,893 | 449 | 302 | 148.73 |
| | 66-70 | 590 | 100 | 0 | n/a |
| | 71-75 | 43 | 0 | 0 | n/a |
| | TOTAL | 6,381,333 | 247,968 | 218,007 | 113.74 |
| **TOTAL** | 16-20 | 16 | 10 | 3 | 328.65 |
| | 21-25 | 18,571 | 2,700 | 2,845 | 94.91 |
| | 26-30 | 238,847 | 22,079 | 26,972 | 81.86 |
| | 31-35 | 659,908 | 44,116 | 47,226 | 93.42 |
| | 36-40 | 1,373,021 | 58,931 | 54,046 | 109.04 |
| | 41-45 | 2,115,624 | 65,454 | 49,130 | 133.23 |
| | 46-50 | 2,916,904 | 79,826 | 61,609 | 129.57 |
| | 51-55 | 2,770,127 | 91,486 | 74,628 | 122.59 |
| | 56-60 | 1,064,018 | 43,952 | 39,398 | 111.56 |
| | 61-65 | 16,656 | 656 | 737 | 89.13 |
| | 66-70 | 2,192 | 194 | 0 | n/a |
| | 71-75 | 220 | 25 | 0 | n/a |
| | TOTAL | 11,176,104 | 409,429 | 356,593 | 114.82 |

# Demographic Assumptions (Continued)

In each of the following sections, the appropriateness of the current assumptions is discussed, and tables are included which compare actual results during the past four years to the "expected" results obtained by applying the current tables to the exposure. A recommendation is then made, and a second group of tables illustrates the relationship between "actual" and "expected" based on any proposed new tables.

## Post-Retirement Mortality

Pension costs are quite sensitive to changes in post-retirement mortality assumptions. Therefore, it is important that mortality tables used in the actuarial valuation adequately reflect post-retirement mortality experience. Mortality rates have been studied based on two major groups of employees, a) the Teachers group consisting of Teachers and Group III members and b) the group consisting of State employees, Political Subdivision employees and Group II members.

In this context, "conservative" tables are tables with low assumed rates of mortality—it is assumed that retirees will continue to live for comparatively long periods of time. Translated into ratios of actual to expected deaths among retirees, a mortality table is "conservative" if ratios of actual to expected are above 100%. If ratios are below 100%, fewer retirees are dying than expected. Since they are living longer than expected, they will receive more benefits from the plan than expected, so more money will have to go into the fund than has been anticipated.

The 1976, 1980, and 1984 studies all showed that retirees, especially teachers, were living longer than expected—that is, the post-retirement mortality tables then in use were not sufficiently conservative. Differences between actual and expected deaths were so great that some question remained as to whether the improvements in mortality were permanent or were due partially to statistical fluctuations. Therefore, the Board adopted an "intermediate" approach. About one-half of the apparent improvement in mortality was recognized in the new tables adopted after the 1980 study, with the understanding that further action could be taken if subsequent studies indicated permanent and/or continuing improvement. In 1984, the full continued improvement in mortality was recognized by adoption of the 1983 Group Annuity Mortality Tables as the basis for expected deaths among teachers and the 1975 Group Annuity Mortality Tables (somewhat less conservative) as the basis for expected deaths among other retirees.

Experience from 1984 to 1988 indicated that the tables adopted as a result of the 1984 study had provided an accurate picture of expected deaths among retirees, and this pattern continued during the period ending in 1992. For the four year period ending in 1996, the ratio of actual to expected mortality declined below 100% among service retirees. As a result of the 1996 study, the male Teachers mortality table was modified to a more conservative basis, while other groups were left unchanged since the ratios were generally above 95%.

Mortality experience in the 2000 study showed continued improvement among both major groups. Overall ratios for both groups declined by almost 4% from 1996 to 2000, with the majority of mortality improvement recognized among males. As a result of the 2000 study, mortality tables were modified for both major groups in order to bring actual to expected ratios back up to 100%.

# Demographic Assumptions (Continued)

Experience in the 2004 study showed continued mortality improvement in the group consisting of State employees, Political Subdivision employees and Group II members. The ratio of actual to expected mortality for this group declined from 100% to 91% since the 2000 study, with males experiencing more mortality improvement than females. Experience of the Teachers group (consisting of Teachers and Group III members) resulted in a reasonably conservative ratio of 103%. As a result of the 2004 study, mortality tables were modified for both major groups in order to bring actual to expected ratios back to 100%.

Experience in the 2008 study showed continued mortality improvement among all groups The ratio of actual to expected mortality for both of the main groups declined from 100% to just below 90% since the 2004 study, with both males and females experiencing consistent mortality improvement during the period. As a result of the 2008 study, mortality tables were modified for both major groups in order to bring actual to expected ratios back to 100%.

Experience in the 2012 study showed modest continued mortality improvement in the group consisting of State employees, Political Subdivision employees and Group II members. The ratio of actual to expected mortality for this group declined from 100% to 96% since the 2008 study, with consistent improvement among males and females. Experience of the Teachers group (consisting of Teachers and Group III members) showed relatively greater improvement with the actual to expected ratio declining from 100% to 87% since the 2008 Study, with males experiencing more mortality improvement than females.

Experience in the 2016 study showed very little change in mortality in the group consisting of State employees, Political Subdivision employees and Group II members. The ratio of actual to expected mortality for this group remained around 100% when compared to the 2012 study, with mortality rates slightly increasing for females (contrary to standard improvement expectations). Experience of the Teachers group (consisting of Teachers and Group III members) showed a significant increase in mortality rates (contrary to standard improvement expectations) with the actual to expected ratio increasing from 100% to 105% since the 2012 study, which was due almost entirely to the female population as the male population showed virtually no change from the 2012 study.

Experience in this study across all groups showed an increase in mortality rates for males and a decrease in mortality rates for females (particularly for the females in the Teachers group). The group consisting of State employees, Political Subdivision employees and Group II members showed a slight overall increase in mortality rates with the actual to expected ratio increasing from 100% to 102% since the 2016 study. Based on the high percentage of females, the Teachers group showed a slight overall decrease in mortality rates with the actual to expected ratio decreasing from 100% to 98% since the 2016 study.

# Demographic Assumptions (Continued)

Mortality experience following disability retirements was also investigated. The number of death claims among disabled retirees is not large enough to be fully credible statistically—disability retirees amount to only a small percentage of TCRS retirees. The results of the study indicate that actual mortality among both males and females is higher than expected. Results for disability mortality continue to be very inconsistent between study periods, suggesting further that experience in this area is less than fully credible.

The tables on the next three pages set out actual deaths, expected deaths, and ratios of actual to expected during the last four years. Actual and expected deaths are weighted by liability amounts to improve accuracy. Expected deaths are based on the base tables used in the 2020 valuation (assumptions adopted after the 2016 experience study). The first two pages show results for service retirees and the third for disability retirees.

# Demographic Assumptions (Continued)

*All Teacher Groups*
*Post-Retirement Mortality*
*Old Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 36-40 | 32,694 | 0 | 16 | 0.00 |
| | 41-45 | 13,624 | 377 | 10 | 3,731.61 |
| | 46-50 | 16,617 | 155 | 26 | 585.57 |
| | 51-55 | 137,256 | 497 | 573 | 86.80 |
| | 56-60 | 715,621 | 3,610 | 3,973 | 90.86 |
| | 61-65 | 2,284,235 | 14,510 | 18,213 | 79.67 |
| | 66-70 | 4,230,830 | 52,644 | 50,979 | 103.27 |
| | 71-75 | 3,658,796 | 65,779 | 71,190 | 92.40 |
| | 76-80 | 1,932,114 | 77,022 | 64,738 | 118.97 |
| | 81-85 | 1,016,694 | 62,267 | 63,382 | 98.24 |
| | 86-90 | 423,277 | 53,789 | 47,447 | 113.37 |
| | 91-95 | 122,377 | 23,484 | 24,980 | 94.01 |
| | TOTAL | 14,584,135 | 354,133 | 345,528 | 102.49 |
| **FEMALE** | 36-40 | 16,566 | 0 | 5 | 0.00 |
| | 41-45 | 13,012 | 0 | 6 | 0.00 |
| | 46-50 | 25,547 | 0 | 30 | 0.00 |
| | 51-55 | 516,086 | 2,153 | 1,359 | 158.41 |
| | 56-60 | 3,037,820 | 9,143 | 11,463 | 79.76 |
| | 61-65 | 8,973,705 | 41,115 | 53,190 | 77.30 |
| | 66-70 | 12,785,257 | 97,163 | 113,242 | 85.80 |
| | 71-75 | 8,154,630 | 94,118 | 114,129 | 82.47 |
| | 76-80 | 3,939,989 | 95,522 | 96,487 | 99.00 |
| | 81-85 | 1,985,326 | 92,892 | 88,762 | 104.65 |
| | 86-90 | 935,114 | 80,258 | 77,047 | 104.17 |
| | 91-95 | 341,428 | 65,713 | 54,144 | 121.37 |
| | TOTAL | 40,724,481 | 578,077 | 609,865 | 94.79 |
| **TOTAL** | 36-40 | 49,260 | 0 | 20 | 0.00 |
| | 41-45 | 26,636 | 377 | 16 | 2,293.29 |
| | 46-50 | 42,164 | 155 | 56 | 276.32 |
| | 51-55 | 653,343 | 2,650 | 1,932 | 137.18 |
| | 56-60 | 3,753,441 | 12,752 | 15,436 | 82.61 |
| | 61-65 | 11,257,940 | 55,625 | 71,403 | 77.90 |
| | 66-70 | 17,016,087 | 149,808 | 164,221 | 91.22 |
| | 71-75 | 11,813,426 | 159,897 | 185,320 | 86.28 |
| | 76-80 | 5,872,103 | 172,544 | 161,225 | 107.02 |
| | 81-85 | 3,002,020 | 155,158 | 152,144 | 101.98 |
| | 86-90 | 1,358,391 | 134,047 | 124,495 | 107.67 |
| | 91-95 | 463,805 | 89,197 | 79,123 | 112.73 |
| | TOTAL | 55,308,616 | 932,210 | 955,393 | 97.57 |

# Demographic Assumptions (Continued)

*Consolidated State, Polisubs & Group II*

*Post-Retirement Mortality*

*Old Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 36-40 | 56,419 | 0 | 46 | 0.00 |
| | 41-45 | 19,976 | 31 | 24 | 130.33 |
| | 46-50 | 45,622 | 0 | 123 | 0.00 |
| | 51-55 | 451,054 | 3,081 | 2,590 | 118.95 |
| | 56-60 | 2,076,757 | 19,744 | 16,823 | 117.37 |
| | 61-65 | 4,613,224 | 62,509 | 55,473 | 112.68 |
| | 66-70 | 6,497,293 | 115,822 | 115,933 | 99.90 |
| | 71-75 | 5,030,822 | 135,790 | 136,315 | 99.62 |
| | 76-80 | 2,825,639 | 135,335 | 125,205 | 108.09 |
| | 81-85 | 1,339,780 | 104,063 | 99,765 | 104.31 |
| | 86-90 | 438,452 | 59,048 | 54,005 | 109.34 |
| | 91-95 | 99,940 | 22,694 | 20,391 | 111.29 |
| | TOTAL | 23,494,978 | 658,117 | 626,693 | 105.01 |
| **FEMALE** | 36-40 | 70,505 | 32 | 26 | 121.64 |
| | 41-45 | 41,426 | 30 | 26 | 111.77 |
| | 46-50 | 87,820 | 0 | 134 | 0.00 |
| | 51-55 | 461,742 | 3,935 | 1,718 | 229.02 |
| | 56-60 | 2,381,349 | 12,337 | 13,130 | 93.96 |
| | 61-65 | 5,708,840 | 39,906 | 45,170 | 88.35 |
| | 66-70 | 7,073,805 | 75,498 | 82,025 | 92.04 |
| | 71-75 | 5,129,949 | 93,409 | 94,303 | 99.05 |
| | 76-80 | 2,899,582 | 87,506 | 90,251 | 96.96 |
| | 81-85 | 1,446,403 | 77,900 | 77,537 | 100.47 |
| | 86-90 | 567,184 | 56,839 | 52,794 | 107.66 |
| | 91-95 | 195,885 | 36,673 | 31,865 | 115.09 |
| | TOTAL | 26,064,490 | 484,065 | 488,981 | 99.00 |
| **TOTAL** | 36-40 | 126,924 | 32 | 72 | 44.58 |
| | 41-45 | 61,402 | 61 | 50 | 120.58 |
| | 46-50 | 133,443 | 0 | 257 | 0.00 |
| | 51-55 | 912,797 | 7,016 | 4,309 | 162.85 |
| | 56-60 | 4,458,106 | 32,081 | 29,953 | 107.10 |
| | 61-65 | 10,322,064 | 102,415 | 100,643 | 101.76 |
| | 66-70 | 13,571,098 | 191,320 | 197,958 | 96.65 |
| | 71-75 | 10,160,771 | 229,199 | 230,618 | 99.39 |
| | 76-80 | 5,725,221 | 222,840 | 215,456 | 103.43 |
| | 81-85 | 2,786,183 | 181,963 | 177,302 | 102.63 |
| | 86-90 | 1,005,636 | 115,887 | 106,799 | 108.51 |
| | 91-95 | 295,825 | 59,366 | 52,256 | 113.61 |
| | TOTAL | 49,559,468 | 1,142,181 | 1,115,674 | 102.38 |

# Demographic Assumptions (Continued)

*All Retirees*
*Post-Disability Mortality*
*Old Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 36-40 | 8,945 | 150 | 144 | 103.66 |
| | 41-45 | 22,440 | 951 | 447 | 212.45 |
| | 46-50 | 49,586 | 1,285 | 1,201 | 106.98 |
| | 51-55 | 101,113 | 3,902 | 3,052 | 127.84 |
| | 56-60 | 165,978 | 5,636 | 6,123 | 92.05 |
| | 61-65 | 157,304 | 7,311 | 7,053 | 103.66 |
| | 66-70 | 114,156 | 6,573 | 6,463 | 101.70 |
| | 71-75 | 57,831 | 4,042 | 4,266 | 94.77 |
| | 76-80 | 18,520 | 2,408 | 1,782 | 135.16 |
| | 81-85 | 5,998 | 811 | 743 | 109.14 |
| | 86-90 | 1,136 | 210 | 190 | 110.49 |
| | 91-95 | 3,615 | 1,027 | 1,058 | 97.04 |
| | TOTAL | 706,621 | 34,307 | 32,524 | 105.48 |
| **FEMALE** | 36-40 | 13,573 | 134 | 179 | 74.94 |
| | 41-45 | 36,355 | 792 | 553 | 143.20 |
| | 46-50 | 85,452 | 3,009 | 1,477 | 203.73 |
| | 51-55 | 205,758 | 4,229 | 4,117 | 102.74 |
| | 56-60 | 288,181 | 9,384 | 6,729 | 139.45 |
| | 61-65 | 315,209 | 8,684 | 8,726 | 99.52 |
| | 66-70 | 218,645 | 7,901 | 7,350 | 107.51 |
| | 71-75 | 120,805 | 6,476 | 5,147 | 125.83 |
| | 76-80 | 49,139 | 3,001 | 2,781 | 107.91 |
| | 81-85 | 14,870 | 1,269 | 1,177 | 107.83 |
| | 86-90 | 6,918 | 800 | 781 | 102.43 |
| | 91-95 | 1,621 | 422 | 271 | 155.85 |
| | TOTAL | 1,356,527 | 46,104 | 39,288 | 117.35 |
| **TOTAL** | 36-40 | 22,518 | 284 | 323 | 87.77 |
| | 41-45 | 58,795 | 1,743 | 1,001 | 174.16 |
| | 46-50 | 135,038 | 4,295 | 2,679 | 160.34 |
| | 51-55 | 306,871 | 8,131 | 7,169 | 113.43 |
| | 56-60 | 454,159 | 15,020 | 12,852 | 116.87 |
| | 61-65 | 472,513 | 15,995 | 15,780 | 101.37 |
| | 66-70 | 332,801 | 14,474 | 13,812 | 104.79 |
| | 71-75 | 178,636 | 10,519 | 9,413 | 111.75 |
| | 76-80 | 67,659 | 5,409 | 4,563 | 118.55 |
| | 81-85 | 20,868 | 2,080 | 1,920 | 108.33 |
| | 86-90 | 8,054 | 1,010 | 971 | 104.01 |
| | 91-95 | 5,236 | 1,449 | 1,329 | 109.03 |
| | TOTAL | 2,063,148 | 80,410 | 71,812 | 111.97 |

# Demographic Assumptions (Continued)

## Recommendation for Post-Retirement Mortality for Service Retirees

Results for both of the main groups (State Employees/Political Subdivisions and Teachers) were mixed. The Teachers showed slightly lower rates of mortality and the State showed slightly higher rates of mortality than the assumptions. It would not be unreasonable to maintain the current mortality tables in light of the results, but incorporating the most current industry tables will maintain transparency and comparability to other retirement systems. These changes are described in more detail under the "Base Tables" and "Projected Improvement" paragraphs below.

***Base Tables:*** The current base mortality tables are created by applying a percentage to selected RP-2006 mortality tables. Constructing customized tables based solely on TCRS experience would produce tables that very closely match TCRS experience at most or all ages, but it is quite difficult for an outside observer to quickly see how the TCRS assumptions compare to other retirement systems. In order to promote transparency and improved comparability to other systems, it is recommended that the base mortality tables continue to be created by applying a percentage to one of the standard industry tables. The Pub-2010 mortality tables (with MP-2020 used to project mortality improvement up to year 2018, the midpoint of the study period) have been selected as they represent the most recent mortality study for public pension plans performed by the Society of Actuaries. The experience of the Teachers most closely matches the Pub-2010 Teachers Below Median Income Table. The experience of the State Employees most closely matches the Pub-2010 General Below Median Income Table. For each group, a separate percentage is applied for males and females to best match the TCRS experience as follows:

| | **Current** | **Recommended** |
|---|---|---|
| Teachers | RP-2006 White Collar<br>Male: 111%<br>Female: 98% | Pub-2010 Teacher Below Median<br>Male: 119%<br>Female: 118% |
| State Employees and Political Subdivisions | RP-2006 Blue Collar<br>Male: 102%<br>Female: 97% | Pub-2010 General Below Median<br>Male: 106%<br>Female: 114% |

The tables on the next two pages show the ratios of actual deaths to expected deaths produced by the recommended base tables above. The ratios for males and females in each of the main groups are very close to 100%, which means the recommended assumption is very close to the actual experience.

# Demographic Assumptions (Continued)

*All Teacher Groups*
*Post-Retirement Mortality*
*Recommended Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 36-40 | 32,694 | 0 | 18 | 0.00 |
| | 41-45 | 13,624 | 377 | 13 | 2,836.83 |
| | 46-50 | 16,617 | 155 | 24 | 658.25 |
| | 51-55 | 137,256 | 497 | 423 | 117.51 |
| | 56-60 | 715,621 | 3,610 | 3,897 | 92.63 |
| | 61-65 | 2,284,235 | 14,510 | 17,383 | 83.47 |
| | 66-70 | 4,230,830 | 52,644 | 48,611 | 108.30 |
| | 71-75 | 3,658,796 | 65,779 | 71,178 | 92.41 |
| | 76-80 | 1,932,114 | 77,022 | 68,315 | 112.75 |
| | 81-85 | 1,016,694 | 62,267 | 67,994 | 91.58 |
| | 86-90 | 423,277 | 53,789 | 50,174 | 107.20 |
| | 91-95 | 122,377 | 23,484 | 26,181 | 89.70 |
| | TOTAL | 14,584,135 | 354,133 | 354,212 | 99.98 |
| **FEMALE** | 36-40 | 16,566 | 0 | 6 | 0.00 |
| | 41-45 | 13,012 | 0 | 8 | 0.00 |
| | 46-50 | 25,547 | 0 | 24 | 0.00 |
| | 51-55 | 516,086 | 2,153 | 1,191 | 180.83 |
| | 56-60 | 3,037,820 | 9,143 | 12,078 | 75.69 |
| | 61-65 | 8,973,705 | 41,115 | 43,439 | 94.65 |
| | 66-70 | 12,785,257 | 97,163 | 88,536 | 109.74 |
| | 71-75 | 8,154,630 | 94,118 | 99,749 | 94.35 |
| | 76-80 | 3,939,989 | 95,522 | 95,534 | 99.99 |
| | 81-85 | 1,985,326 | 92,892 | 94,315 | 98.49 |
| | 86-90 | 935,114 | 80,258 | 84,216 | 95.30 |
| | 91-95 | 341,428 | 65,713 | 61,274 | 107.25 |
| | TOTAL | 40,724,481 | 578,077 | 580,370 | 99.60 |
| **TOTAL** | 36-40 | 49,260 | 0 | 25 | 0.00 |
| | 41-45 | 26,636 | 377 | 21 | 1,761.09 |
| | 46-50 | 42,164 | 155 | 47 | 327.06 |
| | 51-55 | 653,343 | 2,650 | 1,614 | 164.23 |
| | 56-60 | 3,753,441 | 12,752 | 15,975 | 79.83 |
| | 61-65 | 11,257,940 | 55,625 | 60,822 | 91.46 |
| | 66-70 | 17,016,087 | 149,808 | 137,147 | 109.23 |
| | 71-75 | 11,813,426 | 159,897 | 170,927 | 93.55 |
| | 76-80 | 5,872,103 | 172,544 | 163,849 | 105.31 |
| | 81-85 | 3,002,020 | 155,158 | 162,309 | 95.59 |
| | 86-90 | 1,358,391 | 134,047 | 134,390 | 99.74 |
| | 91-95 | 463,805 | 89,197 | 87,455 | 101.99 |
| | TOTAL | 55,308,616 | 932,210 | 934,581 | 99.75 |

# Demographic Assumptions (Continued)

*Consolidated State, Polisubs and Group II*
*Post-Retirement Mortality*
*Recommended Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 36-40 | 56,419 | 0 | 48 | 0.00 |
| | 41-45 | 19,976 | 31 | 27 | 114.47 |
| | 46-50 | 45,622 | 0 | 170 | 0.00 |
| | 51-55 | 451,054 | 3,081 | 3,987 | 77.27 |
| | 56-60 | 2,076,757 | 19,744 | 23,170 | 85.22 |
| | 61-65 | 4,613,224 | 62,509 | 61,355 | 101.88 |
| | 66-70 | 6,497,293 | 115,822 | 115,472 | 100.30 |
| | 71-75 | 5,030,822 | 135,790 | 138,211 | 98.25 |
| | 76-80 | 2,825,639 | 135,335 | 130,107 | 104.02 |
| | 81-85 | 1,339,780 | 104,063 | 106,258 | 97.93 |
| | 86-90 | 438,452 | 59,048 | 57,183 | 103.26 |
| | 91-95 | 99,940 | 22,694 | 20,697 | 109.65 |
| | TOTAL | 23,494,978 | 658,117 | 656,684 | 100.22 |
| **FEMALE** | 36-40 | 70,505 | 32 | 29 | 112.35 |
| | 41-45 | 41,426 | 30 | 29 | 101.60 |
| | 46-50 | 87,820 | 0 | 190 | 0.00 |
| | 51-55 | 461,742 | 3,935 | 2,459 | 160.03 |
| | 56-60 | 2,381,349 | 12,337 | 14,605 | 84.47 |
| | 61-65 | 5,708,840 | 39,906 | 40,584 | 98.33 |
| | 66-70 | 7,073,805 | 75,498 | 71,952 | 104.93 |
| | 71-75 | 5,129,949 | 93,409 | 88,085 | 106.04 |
| | 76-80 | 2,899,582 | 87,506 | 89,373 | 97.91 |
| | 81-85 | 1,446,403 | 77,900 | 80,736 | 96.49 |
| | 86-90 | 567,184 | 56,839 | 58,235 | 97.60 |
| | 91-95 | 195,885 | 36,673 | 36,028 | 101.79 |
| | TOTAL | 26,064,490 | 484,065 | 482,305 | 100.36 |
| **TOTAL** | 36-40 | 126,924 | 32 | 76 | 42.03 |
| | 41-45 | 61,402 | 61 | 56 | 107.82 |
| | 46-50 | 133,443 | 0 | 360 | 0.00 |
| | 51-55 | 912,797 | 7,016 | 6,446 | 108.84 |
| | 56-60 | 4,458,106 | 32,081 | 37,774 | 84.93 |
| | 61-65 | 10,322,064 | 102,415 | 101,939 | 100.47 |
| | 66-70 | 13,571,098 | 191,320 | 187,423 | 102.08 |
| | 71-75 | 10,160,771 | 229,199 | 226,296 | 101.28 |
| | 76-80 | 5,725,221 | 222,840 | 219,480 | 101.53 |
| | 81-85 | 2,786,183 | 181,963 | 186,994 | 97.31 |
| | 86-90 | 1,005,636 | 115,887 | 115,418 | 100.41 |
| | 91-95 | 295,825 | 59,366 | 56,725 | 104.66 |
| | TOTAL | 49,559,468 | 1,142,181 | 1,138,989 | 100.28 |

# Demographic Assumptions (Continued)

***Projected Improvement:*** After selecting the base tables that best match the current TCRS experience, the next step is to determine an assumption for future improvements in mortality. While various prior TCRS studies have seen short-term periods of mortality increasing (the opposite of mortality of improvement), TCRS mortality has shown steady improvement over the long-term. Further, while the continuation of mortality improvements into the future is often debated, the standard expectation across the industry has been to assume generational mortality improvements based on the most recently available scale from the Society of Actuaries (SOA). As of the 2021 valuation date, the most recently available experience study of mortality improvement performed by the SOA is Scale MP-2020, which was published in October 2020. The study for Scale MP-2020 was based on historical Social Security Administration mortality data between 1950 and 2015 along with more recent data from the Centers for Disease Control and Prevention, the U.S. Census Bureau, and the Centers for Medicare and Medicaid Services. Based on TCRS mortality historically showing steady improvement over the long-term, the use of the industry standard generational mortality improvement based on the most recently available scale from the SOA is recommended. Plan Experience regarding mortality improvements will continue to be monitored and adjustments to the standard scale may be considered in future studies if appropriate.

## Recommendation for Disability Retirees

***Base Tables:*** The current study shows an increase in post-disability mortality rates (more actual than expected deaths), but the experience for disability retirees is less than fully credible. As a result, no change is recommended to the base tables in the post-disability mortality assumption. If experience continues to show more actual than expected deaths, then an adjustment to this assumption may be considered in future studies.

***Projected Improvement:*** Similar to the mortality assumption above for service retirees, the post-disability mortality assumptions are used to project expected deaths many years into the future. While the experience over the past four years is showing more actual deaths than expected by the base tables, mortality improvement in the future may cause the actual deaths to be less than expected by the base tables. For consistency across assumptions, it is recommended that the same projected mortality improvement be used for both the service retirees and the disability retirees. Specifically, generational mortality improvement using the most recently available scale from the Society of Actuaries (which is Scale MP-2020 as of the 2021 valuation date) is recommended.

# Demographic Assumptions (Continued)

*All Retirees*
*Post-Disability Mortality*
*Recommended Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 36-40 | 8,945 | 150 | 144 | 103.66 |
| | 41-45 | 22,440 | 951 | 447 | 212.45 |
| | 46-50 | 49,586 | 1,285 | 1,201 | 106.98 |
| | 51-55 | 101,113 | 3,902 | 3,052 | 127.84 |
| | 56-60 | 165,978 | 5,636 | 6,123 | 92.05 |
| | 61-65 | 157,304 | 7,311 | 7,053 | 103.66 |
| | 66-70 | 114,156 | 6,573 | 6,463 | 101.70 |
| | 71-75 | 57,831 | 4,042 | 4,266 | 94.77 |
| | 76-80 | 18,520 | 2,408 | 1,782 | 135.16 |
| | 81-85 | 5,998 | 811 | 743 | 109.14 |
| | 86-90 | 1,136 | 210 | 190 | 110.49 |
| | 91-95 | 3,615 | 1,027 | 1,058 | 97.04 |
| | TOTAL | 706,621 | 34,307 | 32,524 | 105.48 |
| **FEMALE** | 36-40 | 13,573 | 134 | 179 | 74.94 |
| | 41-45 | 36,355 | 792 | 553 | 143.20 |
| | 46-50 | 85,452 | 3,009 | 1,477 | 203.73 |
| | 51-55 | 205,758 | 4,229 | 4,117 | 102.74 |
| | 56-60 | 288,181 | 9,384 | 6,729 | 139.45 |
| | 61-65 | 315,209 | 8,684 | 8,726 | 99.52 |
| | 66-70 | 218,645 | 7,901 | 7,350 | 107.51 |
| | 71-75 | 120,805 | 6,476 | 5,147 | 125.83 |
| | 76-80 | 49,139 | 3,001 | 2,781 | 107.91 |
| | 81-85 | 14,870 | 1,269 | 1,177 | 107.83 |
| | 86-90 | 6,918 | 800 | 781 | 102.43 |
| | 91-95 | 1,621 | 422 | 271 | 155.85 |
| | TOTAL | 1,356,527 | 46,104 | 39,288 | 117.35 |
| **TOTAL** | 36-40 | 22,518 | 284 | 323 | 87.77 |
| | 41-45 | 58,795 | 1,743 | 1,001 | 174.16 |
| | 46-50 | 135,038 | 4,295 | 2,679 | 160.34 |
| | 51-55 | 306,871 | 8,131 | 7,169 | 113.43 |
| | 56-60 | 454,159 | 15,020 | 12,852 | 116.87 |
| | 61-65 | 472,513 | 15,995 | 15,780 | 101.37 |
| | 66-70 | 332,801 | 14,474 | 13,812 | 104.79 |
| | 71-75 | 178,636 | 10,519 | 9,413 | 111.75 |
| | 76-80 | 67,659 | 5,409 | 4,563 | 118.55 |
| | 81-85 | 20,868 | 2,080 | 1,920 | 108.33 |
| | 86-90 | 8,054 | 1,010 | 971 | 104.01 |
| | 91-95 | 5,236 | 1,449 | 1,329 | 109.03 |
| | TOTAL | 2,063,148 | 80,410 | 71,812 | 111.97 |

# Demographic Assumptions (Continued)

## Pre-Retirement Mortality

Pension costs are not particularly sensitive to changes in pre-retirement mortality rates, because the mortality rates at active ages are quite low. Nevertheless, it is desirable to utilize rates which reasonably reflect actuarial experience if possible.

The table on the next page shows the results for active Teachers, and the tables on the following pages show results for Consolidated State and Political Subdivision employees. The results likely do not adequately reflect reality, since deaths appear to be understated. The limited amount of pre-retirement deaths also limits the credibility of this experience.

# Demographic Assumptions (Continued)

*Teachers*

*Pre-Retirement Mortality*

*Old Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 16-20 | 16 | 0 | 0 | n/a |
| | 21-25 | 14,965 | 0 | 9 | 0.00 |
| | 26-30 | 154,074 | 33 | 91 | 36.60 |
| | 31-35 | 407,274 | 62 | 278 | 22.28 |
| | 36-40 | 800,013 | 190 | 611 | 31.12 |
| | 41-45 | 1,284,555 | 1,019 | 1,226 | 83.11 |
| | 46-50 | 1,644,855 | 1,024 | 2,395 | 42.73 |
| | 51-55 | 1,538,398 | 2,950 | 3,676 | 80.24 |
| | 56-60 | 1,362,203 | 4,843 | 5,497 | 88.09 |
| | 61-65 | 906,132 | 3,836 | 6,279 | 61.09 |
| | 66-70 | 229,839 | 795 | 2,616 | 30.40 |
| | 71-75 | 49,563 | 315 | 893 | 35.31 |
| | TOTAL | 8,391,887 | 15,067 | 23,572 | 63.92 |
| **FEMALE** | 16-20 | 78 | 0 | 0 | n/a |
| | 21-25 | 83,794 | 0 | 50 | 0.00 |
| | 26-30 | 660,219 | 48 | 388 | 12.44 |
| | 31-35 | 1,552,999 | 88 | 1,059 | 8.34 |
| | 36-40 | 2,982,699 | 390 | 2,277 | 17.12 |
| | 41-45 | 4,612,248 | 1,511 | 4,407 | 34.28 |
| | 46-50 | 6,010,064 | 2,383 | 11,642 | 20.47 |
| | 51-55 | 5,378,325 | 4,497 | 28,098 | 16.01 |
| | 56-60 | 5,146,080 | 9,115 | 37,517 | 24.30 |
| | 61-65 | 3,124,531 | 5,214 | 31,357 | 16.63 |
| | 66-70 | 812,900 | 3,028 | 11,647 | 25.99 |
| | 71-75 | 121,311 | 659 | 2,574 | 25.61 |
| | TOTAL | 30,485,247 | 26,934 | 131,016 | 20.56 |
| **TOTAL** | 16-20 | 94 | 0 | 0 | n/a |
| | 21-25 | 98,760 | 0 | 59 | 0.00 |
| | 26-30 | 814,293 | 81 | 478 | 17.02 |
| | 31-35 | 1,960,273 | 150 | 1,337 | 11.23 |
| | 36-40 | 3,782,712 | 580 | 2,888 | 20.08 |
| | 41-45 | 5,896,803 | 2,529 | 5,632 | 44.90 |
| | 46-50 | 7,654,919 | 3,407 | 14,037 | 24.27 |
| | 51-55 | 6,916,723 | 7,447 | 31,774 | 23.44 |
| | 56-60 | 6,508,283 | 13,958 | 43,015 | 32.45 |
| | 61-65 | 4,030,662 | 9,050 | 37,636 | 24.05 |
| | 66-70 | 1,042,739 | 3,823 | 14,264 | 26.80 |
| | 71-75 | 170,874 | 975 | 3,467 | 28.11 |
| | TOTAL | 38,877,134 | 42,000 | 154,588 | 27.17 |

# Demographic Assumptions (Continued)

*General State*
*Pre-Retirement Mortality*
*Old Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 16-20 | 794 | 0 | 0 | n/a |
| | 21-25 | 21,024 | 0 | 12 | 0.00 |
| | 26-30 | 129,145 | 68 | 76 | 90.15 |
| | 31-35 | 303,792 | 100 | 207 | 48.34 |
| | 36-40 | 601,030 | 346 | 459 | 75.36 |
| | 41-45 | 900,313 | 1,403 | 863 | 162.70 |
| | 46-50 | 1,439,490 | 2,981 | 2,123 | 140.39 |
| | 51-55 | 1,896,736 | 4,986 | 4,586 | 108.73 |
| | 56-60 | 2,007,437 | 5,786 | 8,136 | 71.11 |
| | 61-65 | 1,631,981 | 8,597 | 11,493 | 74.80 |
| | 66-70 | 806,513 | 5,292 | 9,337 | 56.67 |
| | 71-75 | 238,230 | 2,293 | 4,499 | 50.96 |
| | TOTAL | 9,976,484 | 31,853 | 41,792 | 76.22 |
| **FEMALE** | 16-20 | 285 | 0 | 0 | n/a |
| | 21-25 | 19,592 | 8 | 12 | 72.54 |
| | 26-30 | 152,576 | 12 | 90 | 13.64 |
| | 31-35 | 394,323 | 109 | 269 | 40.60 |
| | 36-40 | 805,018 | 56 | 615 | 9.08 |
| | 41-45 | 1,245,498 | 1,278 | 1,189 | 107.46 |
| | 46-50 | 1,706,844 | 1,337 | 3,434 | 38.94 |
| | 51-55 | 2,532,393 | 920 | 13,413 | 6.86 |
| | 56-60 | 3,044,981 | 4,109 | 22,231 | 18.48 |
| | 61-65 | 2,271,015 | 9,390 | 23,014 | 40.80 |
| | 66-70 | 797,746 | 2,510 | 11,504 | 21.82 |
| | 71-75 | 184,216 | 1,240 | 4,006 | 30.94 |
| | TOTAL | 13,154,487 | 20,970 | 79,776 | 26.29 |
| **TOTAL** | 16-20 | 1,078 | 0 | 0 | n/a |
| | 21-25 | 40,616 | 8 | 24 | 35.11 |
| | 26-30 | 281,721 | 81 | 166 | 48.71 |
| | 31-35 | 698,115 | 209 | 476 | 43.96 |
| | 36-40 | 1,406,049 | 402 | 1,073 | 37.41 |
| | 41-45 | 2,145,811 | 2,681 | 2,052 | 130.68 |
| | 46-50 | 3,146,334 | 4,318 | 5,557 | 77.71 |
| | 51-55 | 4,429,129 | 5,906 | 17,999 | 32.82 |
| | 56-60 | 5,052,418 | 9,895 | 30,368 | 32.59 |
| | 61-65 | 3,902,996 | 17,987 | 34,507 | 52.13 |
| | 66-70 | 1,604,259 | 7,802 | 20,841 | 37.43 |
| | 71-75 | 422,446 | 3,532 | 8,505 | 41.53 |
| | TOTAL | 23,130,971 | 52,822 | 121,568 | 43.45 |

# Demographic Assumptions (Continued)

*Political Subdivisions*
*Pre-Retirement Mortality*
*Old Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 16-20 | 1,799 | 0 | 1 | 0.00 |
| | 21-25 | 49,315 | 18 | 29 | 63.17 |
| | 26-30 | 204,460 | 62 | 120 | 51.85 |
| | 31-35 | 443,463 | 309 | 302 | 102.41 |
| | 36-40 | 743,849 | 325 | 567 | 57.35 |
| | 41-45 | 1,159,870 | 1,029 | 1,114 | 92.38 |
| | 46-50 | 1,744,636 | 1,311 | 2,557 | 51.25 |
| | 51-55 | 2,019,006 | 4,152 | 4,849 | 85.63 |
| | 56-60 | 1,868,370 | 7,956 | 7,517 | 105.84 |
| | 61-65 | 1,293,620 | 7,351 | 9,022 | 81.47 |
| | 66-70 | 402,774 | 3,481 | 4,634 | 75.13 |
| | 71-75 | 151,793 | 1,601 | 2,916 | 54.92 |
| | TOTAL | 10,082,954 | 27,596 | 33,628 | 82.06 |
| **FEMALE** | 16-20 | 494 | 0 | 0 | n/a |
| | 21-25 | 17,450 | 0 | 10 | 0.00 |
| | 26-30 | 80,731 | 15 | 47 | 31.64 |
| | 31-35 | 189,860 | 18 | 130 | 13.64 |
| | 36-40 | 427,405 | 269 | 327 | 82.16 |
| | 41-45 | 753,041 | 462 | 723 | 63.88 |
| | 46-50 | 1,283,313 | 754 | 2,634 | 28.60 |
| | 51-55 | 1,765,255 | 1,937 | 9,318 | 20.79 |
| | 56-60 | 2,133,824 | 4,293 | 15,571 | 27.57 |
| | 61-65 | 1,568,904 | 3,784 | 15,908 | 23.79 |
| | 66-70 | 542,917 | 2,575 | 7,864 | 32.74 |
| | 71-75 | 185,577 | 1,585 | 4,175 | 37.95 |
| | TOTAL | 8,948,770 | 15,690 | 56,707 | 27.67 |
| **TOTAL** | 16-20 | 2,293 | 0 | 1 | 0.00 |
| | 21-25 | 66,765 | 18 | 39 | 46.62 |
| | 26-30 | 285,191 | 77 | 167 | 46.13 |
| | 31-35 | 633,323 | 327 | 431 | 75.75 |
| | 36-40 | 1,171,254 | 594 | 894 | 66.41 |
| | 41-45 | 1,912,911 | 1,490 | 1,836 | 81.16 |
| | 46-50 | 3,027,948 | 2,064 | 5,191 | 39.76 |
| | 51-55 | 3,784,260 | 6,089 | 14,167 | 42.98 |
| | 56-60 | 4,002,194 | 12,250 | 23,088 | 53.06 |
| | 61-65 | 2,862,524 | 11,135 | 24,930 | 44.66 |
| | 66-70 | 945,691 | 6,056 | 12,497 | 48.46 |
| | 71-75 | 337,370 | 3,186 | 7,091 | 44.93 |
| | TOTAL | 19,031,724 | 43,286 | 90,334 | 47.92 |

# Demographic Assumptions (Continued)

## Recommendation for Pre-Retirement Mortality

***Base Tables:*** It is recommended that future expectations of pre-retirement mortality for all groups be based on a standard table. The Pub-2010 mortality tables have been selected as they represent the most recent mortality study for public pension plans performed by the Society of Actuaries. The specific tables are as follows:

| | Current | Recommended |
|---|---|---|
| Teachers | RP-2006 Employees (Total Dataset) | Pub-2010 Teacher Employee (No Income Adjustment) |
| State Employees and Political Subdivisions | RP-2006 Employees (Total Dataset) | Pub-2010 General Employee (No Income Adjustment) |

While both the current and recommended mortality rates are different than reported experience, the resulting tables are expected to reasonably predict the liabilities the System will incur in the future. Usage of a standard table is prudent given the lack of credibility associated with the reported data (including both data collection challenges and the limited number of pre-retirement deaths).

***Projected Improvement:*** The pre-retirement mortality improvement has a much shorter time horizon than the post-retirement mortality improvement (as the post-mortality improvement will continue for many years beyond the retirement date when the pre-retirement mortality no longer applies). While the shorter time horizon makes the pre-retirement mortality improvement less critical than the post-retirement mortality improvement, it should not be ignored. For consistency across assumptions, it is recommended that the same projected mortality improvement be used for both the post-retirement mortality and the pre-retirement mortality. Specifically, generational mortality improvement using the most recently available scale from the Society of Actuaries (which is Scale MP-2020 as of the 2021 valuation date) is recommended.

# Demographic Assumptions (Continued)

## Disability

As is the case with pre-retirement mortality rates, the incidence of disability is so low that overall pension costs are not very sensitive to changes in disability rates.

Disability ratios were inconsistent among all groups with Teachers actual to expected ratio coming in close to 39% while the State and Political Subdivisions were 32% and 27% respectively.

# Demographic Assumptions (Continued)

*Teachers*
*Ordinary Disability*
*Old Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 16-20 | 16 | 0 | 0 | n/a |
| | 21-25 | 14,965 | 0 | 1 | 0.00 |
| | 26-30 | 154,074 | 0 | 13 | 0.00 |
| | 31-35 | 407,274 | 30 | 70 | 42.48 |
| | 36-40 | 800,013 | 0 | 527 | 0.00 |
| | 41-45 | 1,284,555 | 423 | 1,488 | 28.42 |
| | 46-50 | 1,644,855 | 674 | 2,607 | 25.85 |
| | 51-55 | 1,538,398 | 1,554 | 2,674 | 58.13 |
| | 56-60 | 1,362,203 | 1,232 | 1,649 | 74.70 |
| | 61-65 | 906,132 | 0 | 0 | n/a |
| | 66-70 | 229,839 | 0 | 0 | n/a |
| | 71-75 | 49,563 | 0 | 0 | n/a |
| | TOTAL | 8,391,887 | 3,912 | 9,029 | 43.33 |
| **FEMALE** | 16-20 | 78 | 0 | 0 | n/a |
| | 21-25 | 83,794 | 0 | 7 | 0.00 |
| | 26-30 | 660,219 | 0 | 55 | 0.00 |
| | 31-35 | 1,552,999 | 0 | 267 | 0.00 |
| | 36-40 | 2,982,699 | 0 | 1,956 | 0.00 |
| | 41-45 | 4,612,248 | 1,254 | 5,354 | 23.42 |
| | 46-50 | 6,010,064 | 3,656 | 9,527 | 38.37 |
| | 51-55 | 5,378,325 | 4,256 | 9,348 | 45.53 |
| | 56-60 | 5,146,080 | 3,154 | 6,185 | 51.00 |
| | 61-65 | 3,124,531 | 0 | 0 | n/a |
| | 66-70 | 812,900 | 0 | 0 | n/a |
| | 71-75 | 121,311 | 0 | 0 | n/a |
| | TOTAL | 30,485,247 | 12,320 | 32,697 | 37.68 |
| **TOTAL** | 16-20 | 94 | 0 | 0 | n/a |
| | 21-25 | 98,760 | 0 | 8 | 0.00 |
| | 26-30 | 814,293 | 0 | 68 | 0.00 |
| | 31-35 | 1,960,273 | 30 | 337 | 8.83 |
| | 36-40 | 3,782,712 | 0 | 2,483 | 0.00 |
| | 41-45 | 5,896,803 | 1,677 | 6,842 | 24.50 |
| | 46-50 | 7,654,919 | 4,330 | 12,134 | 35.68 |
| | 51-55 | 6,916,723 | 5,810 | 12,021 | 48.33 |
| | 56-60 | 6,508,283 | 4,386 | 7,833 | 55.99 |
| | 61-65 | 4,030,662 | 0 | 0 | n/a |
| | 66-70 | 1,042,739 | 0 | 0 | n/a |
| | 71-75 | 170,874 | 0 | 0 | n/a |
| | TOTAL | 38,877,134 | 16,232 | 41,725 | 38.90 |

# Demographic Assumptions (Continued)

*General State*
*Ordinary Disability*
*Old Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 16-20 | 794 | 0 | 1 | 0.00 |
| | 21-25 | 21,024 | 0 | 14 | 0.00 |
| | 26-30 | 129,145 | 0 | 88 | 0.00 |
| | 31-35 | 303,792 | 210 | 283 | 74.16 |
| | 36-40 | 601,030 | 293 | 856 | 34.27 |
| | 41-45 | 900,313 | 549 | 1,752 | 31.30 |
| | 46-50 | 1,439,490 | 1,115 | 3,708 | 30.06 |
| | 51-55 | 1,896,736 | 1,896 | 5,240 | 36.19 |
| | 56-60 | 2,007,437 | 2,392 | 4,114 | 58.15 |
| | 61-65 | 1,631,981 | 0 | 0 | n/a |
| | 66-70 | 806,513 | 0 | 0 | n/a |
| | 71-75 | 238,230 | 0 | 0 | n/a |
| | TOTAL | 9,976,484 | 6,455 | 16,056 | 40.20 |
| **FEMALE** | 16-20 | 285 | 0 | 0 | n/a |
| | 21-25 | 19,592 | 0 | 6 | 0.00 |
| | 26-30 | 152,576 | 0 | 48 | 0.00 |
| | 31-35 | 394,323 | 34 | 207 | 16.64 |
| | 36-40 | 805,018 | 0 | 885 | 0.00 |
| | 41-45 | 1,245,498 | 438 | 2,490 | 17.60 |
| | 46-50 | 1,706,844 | 1,726 | 4,999 | 34.52 |
| | 51-55 | 2,532,393 | 2,512 | 9,292 | 27.03 |
| | 56-60 | 3,044,981 | 2,478 | 8,794 | 28.18 |
| | 61-65 | 2,271,015 | 0 | 0 | n/a |
| | 66-70 | 797,746 | 0 | 0 | n/a |
| | 71-75 | 184,216 | 0 | 0 | n/a |
| | TOTAL | 13,154,487 | 7,188 | 26,721 | 26.90 |
| **TOTAL** | 16-20 | 1,078 | 0 | 1 | 0.00 |
| | 21-25 | 40,616 | 0 | 19 | 0.00 |
| | 26-30 | 281,721 | 0 | 137 | 0.00 |
| | 31-35 | 698,115 | 244 | 490 | 49.85 |
| | 36-40 | 1,406,049 | 293 | 1,741 | 16.85 |
| | 41-45 | 2,145,811 | 987 | 4,242 | 23.26 |
| | 46-50 | 3,146,334 | 2,840 | 8,707 | 32.62 |
| | 51-55 | 4,429,129 | 4,408 | 14,532 | 30.33 |
| | 56-60 | 5,052,418 | 4,870 | 12,908 | 37.73 |
| | 61-65 | 3,902,996 | 0 | 0 | n/a |
| | 66-70 | 1,604,259 | 0 | 0 | n/a |
| | 71-75 | 422,446 | 0 | 0 | n/a |
| | TOTAL | 23,130,971 | 13,643 | 42,777 | 31.89 |

# Demographic Assumptions (Continued)

*Political Subdivisions*
*Ordinary Disability*
*Old Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 16-20 | 1,799 | 0 | 1 | 0.00 |
| | 21-25 | 49,315 | 0 | 16 | 0.00 |
| | 26-30 | 204,460 | 0 | 66 | 0.00 |
| | 31-35 | 443,463 | 51 | 143 | 35.58 |
| | 36-40 | 743,849 | 124 | 435 | 28.49 |
| | 41-45 | 1,159,870 | 317 | 1,747 | 18.15 |
| | 46-50 | 1,744,636 | 444 | 5,320 | 8.34 |
| | 51-55 | 2,019,006 | 3,157 | 9,272 | 34.04 |
| | 56-60 | 1,868,370 | 3,573 | 7,519 | 47.52 |
| | 61-65 | 1,293,620 | 0 | 0 | n/a |
| | 66-70 | 402,774 | 0 | 0 | n/a |
| | 71-75 | 151,793 | 0 | 0 | n/a |
| | TOTAL | 10,082,954 | 7,665 | 24,519 | 31.26 |
| **FEMALE** | 16-20 | 494 | 0 | 0 | n/a |
| | 21-25 | 17,450 | 0 | 6 | 0.00 |
| | 26-30 | 80,731 | 0 | 26 | 0.00 |
| | 31-35 | 189,860 | 0 | 61 | 0.00 |
| | 36-40 | 427,405 | 53 | 256 | 20.89 |
| | 41-45 | 753,041 | 84 | 1,134 | 7.44 |
| | 46-50 | 1,283,313 | 1,061 | 3,959 | 26.81 |
| | 51-55 | 1,765,255 | 1,869 | 8,138 | 22.97 |
| | 56-60 | 2,133,824 | 1,996 | 8,467 | 23.58 |
| | 61-65 | 1,568,904 | 0 | 0 | n/a |
| | 66-70 | 542,917 | 0 | 0 | n/a |
| | 71-75 | 185,577 | 0 | 0 | n/a |
| | TOTAL | 8,948,770 | 5,065 | 22,046 | 22.97 |
| **TOTAL** | 16-20 | 2,293 | 0 | 1 | 0.00 |
| | 21-25 | 66,765 | 0 | 21 | 0.00 |
| | 26-30 | 285,191 | 0 | 92 | 0.00 |
| | 31-35 | 633,323 | 51 | 204 | 24.91 |
| | 36-40 | 1,171,254 | 177 | 690 | 25.67 |
| | 41-45 | 1,912,911 | 402 | 2,882 | 13.93 |
| | 46-50 | 3,027,948 | 1,505 | 9,279 | 16.22 |
| | 51-55 | 3,784,260 | 5,026 | 17,410 | 28.87 |
| | 56-60 | 4,002,194 | 5,569 | 15,986 | 34.84 |
| | 61-65 | 2,862,524 | 0 | 0 | n/a |
| | 66-70 | 945,691 | 0 | 0 | n/a |
| | 71-75 | 337,370 | 0 | 0 | n/a |
| | TOTAL | 19,031,724 | 12,730 | 46,564 | 27.34 |

# Demographic Assumptions (Continued)

## Recommendation for Disability

The economy since 2008 (covering the last three study periods) has experienced a difficult and unusual period of economic recession followed by a strong recovery which likely influenced participant behavior. As such, the disability experience during this period may not be credible for long-term future predictions. In addition, the incidence of disability is so low that overall pension costs are not very sensitive to changes in disability rates. No change is recommended to the current assumption.

# Demographic Assumptions (Continued)

## Turnover

Nine pages of tables are included to illustrate ratios of actual to expected turnover. A "two-year select and ultimate" approach has been used. That is, separate rates are examined for the first year of participation, the second year of participation, and an aggregate rate (by age and sex) is utilized thereafter. The "ultimate" tables are more important than the "first-year" and "second-year" tables because the "ultimate" tables apply throughout most of an individual's career.

It should be noted that ratios in excess of 100% are "conservative" with respect to turnover. If turnover is higher than expected, fewer employees will remain until retirement, so fewer benefits will be paid. However, turnover tends to fluctuate with the general condition of the economy, so substantial fluctuations should be expected between high-growth periods (jobs are plentiful, and turnover is high) and low-growth periods (options are limited, and turnover is low).

# Demographic Assumptions (Continued)

*Teachers*
*1st Year Withdrawal*
*Old Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 16-20 | 6 | 0 | 1 | 0.00 |
| | 21-25 | 2,449 | 417 | 441 | 94.61 |
| | 26-30 | 3,074 | 518 | 553 | 93.63 |
| | 31-35 | 1,939 | 328 | 349 | 93.89 |
| | 36-40 | 1,790 | 363 | 322 | 112.55 |
| | 41-45 | 1,582 | 237 | 287 | 82.78 |
| | 46-50 | 1,449 | 251 | 276 | 90.90 |
| | 51-55 | 1,062 | 227 | 222 | 102.12 |
| | 56-60 | 687 | 195 | 163 | 119.10 |
| | 61-65 | 364 | 96 | 98 | 98.22 |
| | 66-70 | 98 | 25 | 27 | n/a |
| | 71-75 | 28 | 0 | 0 | n/a |
| | TOTAL | 14,526 | 2,657 | 2,740 | 96.95 |
| **FEMALE** | 16-20 | 23 | 2 | 4 | 59.64 |
| | 21-25 | 12,437 | 1,327 | 2,239 | 59.26 |
| | 26-30 | 11,019 | 1,723 | 1,984 | 86.86 |
| | 31-35 | 6,856 | 1,053 | 1,234 | 85.30 |
| | 36-40 | 5,662 | 826 | 1,019 | 81.08 |
| | 41-45 | 5,599 | 766 | 1,015 | 75.47 |
| | 46-50 | 4,392 | 645 | 837 | 77.05 |
| | 51-55 | 2,853 | 468 | 600 | 77.96 |
| | 56-60 | 1,790 | 241 | 427 | 56.47 |
| | 61-65 | 817 | 205 | 222 | 92.36 |
| | 66-70 | 141 | 57 | 40 | n/a |
| | 71-75 | 44 | 30 | 4 | 850.47 |
| | TOTAL | 51,634 | 7,344 | 9,624 | 76.30 |
| **TOTAL** | 16-20 | 29 | 2 | 5 | 47.69 |
| | 21-25 | 14,886 | 1,744 | 2,679 | 65.07 |
| | 26-30 | 14,093 | 2,241 | 2,537 | 88.34 |
| | 31-35 | 8,795 | 1,380 | 1,583 | 87.19 |
| | 36-40 | 7,452 | 1,189 | 1,341 | 88.64 |
| | 41-45 | 7,180 | 1,003 | 1,302 | 77.08 |
| | 46-50 | 5,841 | 896 | 1,114 | 80.49 |
| | 51-55 | 3,915 | 695 | 822 | 84.49 |
| | 56-60 | 2,478 | 436 | 591 | 73.80 |
| | 61-65 | 1,181 | 302 | 321 | 94.15 |
| | 66-70 | 239 | 82 | 67 | n/a |
| | 71-75 | 72 | 30 | 4 | n/a |
| | TOTAL | 66,160 | 10,001 | 12,365 | 80.88 |

# Demographic Assumptions (Continued)

*General State*
*1st Year Withdrawal*
*Old Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 16-20 | 582 | 243 | 178 | 136.64 |
| | 21-25 | 4,423 | 1,162 | 1,156 | 100.52 |
| | 26-30 | 6,261 | 1,386 | 1,498 | 92.51 |
| | 31-35 | 5,191 | 993 | 1,126 | 88.16 |
| | 36-40 | 4,596 | 783 | 900 | 87.02 |
| | 41-45 | 3,692 | 733 | 640 | 114.44 |
| | 46-50 | 3,681 | 650 | 569 | 114.30 |
| | 51-55 | 3,271 | 428 | 489 | 87.41 |
| | 56-60 | 3,019 | 491 | 497 | 98.80 |
| | 61-65 | 1,417 | 329 | 290 | 113.21 |
| | 66-70 | 439 | 153 | 115 | n/a |
| | 71-75 | 168 | 42 | 8 | n/a |
| | TOTAL | 36,741 | 7,392 | 7,467 | 99.00 |
| **FEMALE** | 16-20 | 220 | 96 | 67 | 142.29 |
| | 21-25 | 5,367 | 1,396 | 1,394 | 100.12 |
| | 26-30 | 8,490 | 1,825 | 2,032 | 89.79 |
| | 31-35 | 7,089 | 1,329 | 1,538 | 86.43 |
| | 36-40 | 5,989 | 1,042 | 1,166 | 89.36 |
| | 41-45 | 5,656 | 977 | 980 | 99.72 |
| | 46-50 | 4,709 | 891 | 729 | 122.24 |
| | 51-55 | 4,064 | 584 | 608 | 96.07 |
| | 56-60 | 2,810 | 459 | 464 | 98.88 |
| | 61-65 | 1,149 | 263 | 238 | 110.53 |
| | 66-70 | 216 | 63 | 57 | n/a |
| | 71-75 | 43 | 15 | 5 | n/a |
| | TOTAL | 45,801 | 8,938 | 9,277 | 96.35 |
| **TOTAL** | 16-20 | 801 | 338 | 245 | 138.19 |
| | 21-25 | 9,790 | 2,558 | 2,551 | 100.30 |
| | 26-30 | 14,751 | 3,210 | 3,530 | 90.94 |
| | 31-35 | 12,281 | 2,322 | 2,664 | 87.16 |
| | 36-40 | 10,584 | 1,824 | 2,065 | 88.34 |
| | 41-45 | 9,348 | 1,710 | 1,620 | 105.54 |
| | 46-50 | 8,390 | 1,541 | 1,297 | 118.76 |
| | 51-55 | 7,334 | 1,011 | 1,097 | 92.20 |
| | 56-60 | 5,830 | 950 | 961 | 98.84 |
| | 61-65 | 2,566 | 591 | 528 | 112.00 |
| | 66-70 | 655 | 216 | 172 | n/a |
| | 71-75 | 211 | 58 | 13 | n/a |
| | TOTAL | 82,542 | 16,331 | 16,743 | 97.54 |

# Demographic Assumptions (Continued)

*Political Subdivisions*
*1st Year Withdrawal*
*Old Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 16-20 | 1,250 | 296 | 331 | 89.58 |
| | 21-25 | 8,111 | 1,588 | 1,941 | 81.81 |
| | 26-30 | 7,657 | 1,429 | 1,710 | 83.58 |
| | 31-35 | 5,138 | 953 | 1,088 | 87.59 |
| | 36-40 | 4,611 | 706 | 914 | 77.20 |
| | 41-45 | 4,295 | 715 | 785 | 91.10 |
| | 46-50 | 4,251 | 587 | 729 | 80.47 |
| | 51-55 | 3,545 | 467 | 606 | 77.13 |
| | 56-60 | 3,063 | 384 | 578 | 66.43 |
| | 61-65 | 1,690 | 217 | 392 | 55.33 |
| | 66-70 | 758 | 136 | 199 | n/a |
| | 71-75 | 267 | 54 | 22 | n/a |
| | TOTAL | 44,636 | 7,532 | 9,295 | 81.03 |
| **FEMALE** | 16-20 | 363 | 114 | 96 | 118.94 |
| | 21-25 | 4,698 | 1,210 | 1,115 | 108.53 |
| | 26-30 | 6,244 | 1,272 | 1,392 | 91.39 |
| | 31-35 | 5,384 | 966 | 1,138 | 84.87 |
| | 36-40 | 6,184 | 1,140 | 1,226 | 93.02 |
| | 41-45 | 5,537 | 958 | 1,012 | 94.68 |
| | 46-50 | 5,597 | 976 | 960 | 101.70 |
| | 51-55 | 4,979 | 763 | 850 | 89.77 |
| | 56-60 | 3,730 | 497 | 701 | 71.00 |
| | 61-65 | 1,809 | 300 | 420 | 71.38 |
| | 66-70 | 510 | 124 | 134 | n/a |
| | 71-75 | 131 | 32 | 14 | n/a |
| | TOTAL | 45,165 | 8,354 | 9,058 | 92.23 |
| **TOTAL** | 16-20 | 1,614 | 411 | 427 | 96.20 |
| | 21-25 | 12,808 | 2,798 | 3,056 | 91.56 |
| | 26-30 | 13,901 | 2,701 | 3,102 | 87.09 |
| | 31-35 | 10,522 | 1,919 | 2,226 | 86.20 |
| | 36-40 | 10,795 | 1,846 | 2,140 | 86.26 |
| | 41-45 | 9,832 | 1,673 | 1,797 | 93.12 |
| | 46-50 | 9,848 | 1,563 | 1,689 | 92.54 |
| | 51-55 | 8,524 | 1,230 | 1,456 | 84.51 |
| | 56-60 | 6,793 | 882 | 1,279 | 68.93 |
| | 61-65 | 3,498 | 517 | 812 | 63.62 |
| | 66-70 | 1,269 | 260 | 334 | n/a |
| | 71-75 | 398 | 86 | 36 | n/a |
| | TOTAL | 89,802 | 15,886 | 18,353 | 86.55 |

# Demographic Assumptions (Continued)

*Teachers*
*2nd Year Withdrawal*
*Old Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 16-20 | 0 | 0 | 0 | n/a |
| | 21-25 | 5,974 | 840 | 807 | 104.13 |
| | 26-30 | 10,819 | 1,241 | 1,461 | 84.94 |
| | 31-35 | 6,111 | 813 | 825 | 98.55 |
| | 36-40 | 5,135 | 744 | 693 | 107.26 |
| | 41-45 | 4,963 | 574 | 670 | 85.61 |
| | 46-50 | 4,413 | 414 | 607 | 68.22 |
| | 51-55 | 3,004 | 366 | 469 | 78.03 |
| | 56-60 | 1,534 | 165 | 298 | 55.43 |
| | 61-65 | 1,070 | 332 | 250 | 132.63 |
| | 66-70 | 296 | 62 | 70 | n/a |
| | 71-75 | 118 | 65 | 14 | n/a |
| | TOTAL | 43,439 | 5,613 | 6,162 | 91.10 |
| **FEMALE** | 16-20 | 46 | 5 | 6 | 75.84 |
| | 21-25 | 31,839 | 3,460 | 4,298 | 80.49 |
| | 26-30 | 38,540 | 4,989 | 5,203 | 95.88 |
| | 31-35 | 20,147 | 2,438 | 2,720 | 89.64 |
| | 36-40 | 17,917 | 1,863 | 2,419 | 77.03 |
| | 41-45 | 15,537 | 1,904 | 2,097 | 90.75 |
| | 46-50 | 13,373 | 1,276 | 1,830 | 69.71 |
| | 51-55 | 8,316 | 899 | 1,294 | 69.51 |
| | 56-60 | 6,199 | 613 | 1,196 | 51.28 |
| | 61-65 | 2,353 | 367 | 550 | 66.81 |
| | 66-70 | 326 | 32 | 77 | n/a |
| | 71-75 | 67 | 16 | 6 | 279.84 |
| | TOTAL | 154,659 | 17,862 | 21,696 | 82.33 |
| **TOTAL** | 16-20 | 46 | 5 | 6 | 75.84 |
| | 21-25 | 37,813 | 4,299 | 5,105 | 84.22 |
| | 26-30 | 49,359 | 6,229 | 6,663 | 93.48 |
| | 31-35 | 26,258 | 3,251 | 3,545 | 91.71 |
| | 36-40 | 23,052 | 2,607 | 3,112 | 83.76 |
| | 41-45 | 20,500 | 2,477 | 2,767 | 89.51 |
| | 46-50 | 17,786 | 1,689 | 2,437 | 69.33 |
| | 51-55 | 11,320 | 1,265 | 1,763 | 71.78 |
| | 56-60 | 7,734 | 778 | 1,494 | 52.10 |
| | 61-65 | 3,423 | 699 | 800 | 87.38 |
| | 66-70 | 622 | 94 | 146 | n/a |
| | 71-75 | 185 | 81 | 20 | n/a |
| | TOTAL | 198,098 | 23,475 | 27,858 | 84.27 |

# Demographic Assumptions (Continued)

*General State*
*2nd Year Withdrawal*
*Old Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 16-20 | 206 | 62 | 51 | 122.33 |
| | 21-25 | 5,689 | 1,269 | 1,257 | 100.96 |
| | 26-30 | 11,822 | 1,847 | 2,326 | 79.40 |
| | 31-35 | 11,298 | 1,639 | 1,931 | 84.90 |
| | 36-40 | 9,702 | 1,449 | 1,428 | 101.47 |
| | 41-45 | 8,214 | 948 | 1,042 | 90.96 |
| | 46-50 | 7,554 | 987 | 859 | 114.93 |
| | 51-55 | 7,018 | 735 | 789 | 93.16 |
| | 56-60 | 7,631 | 800 | 985 | 81.22 |
| | 61-65 | 4,000 | 439 | 689 | 63.71 |
| | 66-70 | 990 | 115 | 220 | n/a |
| | 71-75 | 278 | 24 | 14 | n/a |
| | TOTAL | 74,400 | 10,316 | 11,591 | 89.00 |
| **FEMALE** | 16-20 | 56 | 18 | 14 | 129.10 |
| | 21-25 | 6,566 | 1,258 | 1,438 | 87.49 |
| | 26-30 | 16,300 | 2,729 | 3,208 | 85.07 |
| | 31-35 | 14,629 | 2,106 | 2,501 | 84.19 |
| | 36-40 | 12,742 | 1,498 | 1,875 | 79.89 |
| | 41-45 | 12,625 | 1,668 | 1,605 | 103.96 |
| | 46-50 | 10,599 | 1,177 | 1,209 | 97.38 |
| | 51-55 | 9,613 | 1,044 | 1,081 | 96.53 |
| | 56-60 | 7,184 | 838 | 924 | 90.73 |
| | 61-65 | 2,694 | 257 | 458 | 56.17 |
| | 66-70 | 639 | 24 | 142 | n/a |
| | 71-75 | 182 | 44 | 31 | n/a |
| | TOTAL | 93,827 | 12,661 | 14,485 | 87.41 |
| **TOTAL** | 16-20 | 261 | 80 | 64 | 123.77 |
| | 21-25 | 12,255 | 2,527 | 2,695 | 93.77 |
| | 26-30 | 28,123 | 4,575 | 5,533 | 82.68 |
| | 31-35 | 25,927 | 3,745 | 4,432 | 84.50 |
| | 36-40 | 22,444 | 2,947 | 3,303 | 89.22 |
| | 41-45 | 20,839 | 2,616 | 2,647 | 98.84 |
| | 46-50 | 18,152 | 2,165 | 2,068 | 104.67 |
| | 51-55 | 16,631 | 1,779 | 1,870 | 95.11 |
| | 56-60 | 14,814 | 1,639 | 1,909 | 85.83 |
| | 61-65 | 6,694 | 696 | 1,148 | 60.70 |
| | 66-70 | 1,629 | 140 | 362 | n/a |
| | 71-75 | 459 | 69 | 45 | n/a |
| | TOTAL | 168,228 | 22,977 | 26,076 | 88.12 |

# Demographic Assumptions (Continued)

*Political Subdivisions*
*2nd Year Withdrawal*
*Old Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 16-20 | 517 | 77 | 113 | 68.21 |
| | 21-25 | 11,010 | 1,603 | 2,178 | 73.63 |
| | 26-30 | 14,141 | 2,233 | 2,571 | 86.83 |
| | 31-35 | 9,906 | 1,325 | 1,722 | 76.94 |
| | 36-40 | 8,440 | 1,098 | 1,380 | 79.55 |
| | 41-45 | 8,624 | 957 | 1,277 | 74.90 |
| | 46-50 | 8,038 | 955 | 1,079 | 88.44 |
| | 51-55 | 7,564 | 636 | 974 | 65.34 |
| | 56-60 | 6,670 | 492 | 929 | 52.95 |
| | 61-65 | 3,710 | 395 | 631 | 62.67 |
| | 66-70 | 1,353 | 159 | 288 | n/a |
| | 71-75 | 426 | 86 | 37 | n/a |
| | TOTAL | 80,398 | 10,016 | 13,179 | 76.00 |
| **FEMALE** | 16-20 | 116 | 21 | 25 | 83.91 |
| | 21-25 | 4,750 | 803 | 931 | 86.28 |
| | 26-30 | 9,977 | 1,540 | 1,812 | 84.98 |
| | 31-35 | 9,813 | 1,433 | 1,702 | 84.23 |
| | 36-40 | 11,473 | 1,498 | 1,873 | 80.00 |
| | 41-45 | 11,910 | 1,563 | 1,758 | 88.90 |
| | 46-50 | 11,554 | 1,197 | 1,551 | 77.18 |
| | 51-55 | 10,829 | 1,289 | 1,395 | 92.45 |
| | 56-60 | 7,983 | 859 | 1,111 | 77.37 |
| | 61-65 | 3,977 | 587 | 668 | 87.82 |
| | 66-70 | 923 | 164 | 196 | n/a |
| | 71-75 | 246 | 42 | 19 | n/a |
| | TOTAL | 83,550 | 10,997 | 13,040 | 84.33 |
| **TOTAL** | 16-20 | 633 | 98 | 138 | 71.09 |
| | 21-25 | 15,759 | 2,407 | 3,109 | 77.42 |
| | 26-30 | 24,118 | 3,772 | 4,383 | 86.06 |
| | 31-35 | 19,719 | 2,758 | 3,423 | 80.56 |
| | 36-40 | 19,913 | 2,596 | 3,253 | 79.81 |
| | 41-45 | 20,535 | 2,520 | 3,035 | 83.01 |
| | 46-50 | 19,592 | 2,152 | 2,631 | 81.80 |
| | 51-55 | 18,393 | 1,926 | 2,369 | 81.30 |
| | 56-60 | 14,653 | 1,351 | 2,040 | 66.25 |
| | 61-65 | 7,687 | 982 | 1,299 | 75.61 |
| | 66-70 | 2,275 | 323 | 484 | n/a |
| | 71-75 | 672 | 128 | 56 | n/a |
| | TOTAL | 163,949 | 21,013 | 26,220 | 80.14 |

# Demographic Assumptions (Continued)

*Teachers*
*Ultimate Withdrawal*
*Old Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 16-20 | 10 | 0 | 1 | 0.00 |
| | 21-25 | 6,542 | 1,013 | 560 | 180.70 |
| | 26-30 | 140,181 | 10,448 | 9,415 | 110.97 |
| | 31-35 | 399,224 | 16,975 | 17,525 | 96.86 |
| | 36-40 | 793,088 | 24,224 | 19,795 | 122.38 |
| | 41-45 | 1,278,010 | 21,348 | 20,163 | 105.88 |
| | 46-50 | 1,622,191 | 22,072 | 27,433 | 80.46 |
| | 51-55 | 1,060,187 | 23,118 | 27,442 | 84.24 |
| | 56-60 | 281,645 | 11,699 | 10,469 | 111.75 |
| | 61-65 | 644 | 53 | 32 | 167.39 |
| | 66-70 | 197 | 38 | 0 | n/a |
| | 71-75 | 82 | 58 | 0 | n/a |
| | TOTAL | 5,582,003 | 131,044 | 132,835 | 98.65 |
| **FEMALE** | 16-20 | 8 | 0 | 1 | 0.00 |
| | 21-25 | 39,519 | 4,520 | 3,977 | 113.65 |
| | 26-30 | 610,660 | 48,542 | 51,171 | 94.86 |
| | 31-35 | 1,525,995 | 64,249 | 85,874 | 74.82 |
| | 36-40 | 2,959,120 | 73,030 | 89,716 | 81.40 |
| | 41-45 | 4,591,112 | 73,885 | 65,114 | 113.47 |
| | 46-50 | 5,893,031 | 83,115 | 75,085 | 110.69 |
| | 51-55 | 3,565,753 | 86,215 | 97,346 | 88.57 |
| | 56-60 | 1,153,119 | 46,324 | 54,647 | 84.77 |
| | 61-65 | 1,318 | 248 | 55 | 452.60 |
| | 66-70 | 491 | 185 | 0 | n/a |
| | 71-75 | 21 | 0 | 0 | n/a |
| | TOTAL | 20,340,147 | 480,313 | 522,986 | 91.84 |
| **TOTAL** | 16-20 | 18 | 0 | 2 | 0.00 |
| | 21-25 | 46,061 | 5,533 | 4,538 | 121.93 |
| | 26-30 | 750,841 | 58,990 | 60,586 | 97.36 |
| | 31-35 | 1,925,220 | 81,224 | 103,399 | 78.55 |
| | 36-40 | 3,752,208 | 97,254 | 109,511 | 88.81 |
| | 41-45 | 5,869,123 | 95,233 | 85,277 | 111.68 |
| | 46-50 | 7,515,222 | 105,187 | 102,518 | 102.60 |
| | 51-55 | 4,625,940 | 109,333 | 124,788 | 87.61 |
| | 56-60 | 1,434,765 | 58,023 | 65,116 | 89.11 |
| | 61-65 | 1,962 | 300 | 86 | 348.26 |
| | 66-70 | 688 | 223 | 0 | n/a |
| | 71-75 | 102 | 58 | 0 | n/a |
| | TOTAL | 25,922,150 | 611,358 | 655,821 | 93.22 |

# Demographic Assumptions (Continued)

*General State*
*Ultimate Withdrawal*
*Old Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 16-20 | 7 | 0 | 1 | 0.00 |
| | 21-25 | 10,912 | 1,569 | 1,679 | 93.49 |
| | 26-30 | 111,062 | 9,807 | 12,166 | 80.62 |
| | 31-35 | 287,303 | 17,594 | 19,023 | 92.49 |
| | 36-40 | 586,733 | 24,637 | 19,836 | 124.20 |
| | 41-45 | 888,407 | 26,224 | 17,447 | 150.30 |
| | 46-50 | 1,335,996 | 33,425 | 26,645 | 125.45 |
| | 51-55 | 1,149,191 | 33,469 | 27,093 | 123.53 |
| | 56-60 | 412,618 | 14,408 | 14,262 | 101.03 |
| | 61-65 | 10,763 | 208 | 435 | 47.77 |
| | 66-70 | 1,603 | 94 | 0 | n/a |
| | 71-75 | 177 | 25 | 0 | n/a |
| | TOTAL | 4,794,771 | 161,461 | 138,586 | 116.51 |
| **FEMALE** | 16-20 | 10 | 10 | 2 | 545.88 |
| | 21-25 | 7,659 | 1,131 | 1,166 | 96.94 |
| | 26-30 | 127,785 | 12,271 | 14,806 | 82.88 |
| | 31-35 | 372,605 | 26,522 | 28,203 | 94.04 |
| | 36-40 | 786,288 | 34,293 | 34,209 | 100.25 |
| | 41-45 | 1,227,217 | 39,230 | 31,682 | 123.82 |
| | 46-50 | 1,580,908 | 46,401 | 34,964 | 132.71 |
| | 51-55 | 1,620,936 | 58,018 | 47,536 | 122.05 |
| | 56-60 | 651,399 | 29,544 | 25,136 | 117.53 |
| | 61-65 | 5,893 | 449 | 302 | 148.73 |
| | 66-70 | 590 | 100 | 0 | n/a |
| | 71-75 | 43 | 0 | 0 | n/a |
| | TOTAL | 6,381,333 | 247,968 | 218,007 | 113.74 |
| **TOTAL** | 16-20 | 16 | 10 | 3 | 328.65 |
| | 21-25 | 18,571 | 2,700 | 2,845 | 94.91 |
| | 26-30 | 238,847 | 22,079 | 26,972 | 81.86 |
| | 31-35 | 659,908 | 44,116 | 47,226 | 93.42 |
| | 36-40 | 1,373,021 | 58,931 | 54,046 | 109.04 |
| | 41-45 | 2,115,624 | 65,454 | 49,130 | 133.23 |
| | 46-50 | 2,916,904 | 79,826 | 61,609 | 129.57 |
| | 51-55 | 2,770,127 | 91,486 | 74,628 | 122.59 |
| | 56-60 | 1,064,018 | 43,952 | 39,398 | 111.56 |
| | 61-65 | 16,656 | 656 | 737 | 89.13 |
| | 66-70 | 2,192 | 194 | 0 | n/a |
| | 71-75 | 220 | 25 | 0 | n/a |
| | TOTAL | 11,176,104 | 409,429 | 356,593 | 114.82 |

# Demographic Assumptions (Continued)

*Political Subdivisions*
*Ultimate Withdrawal*
*Old Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 16-20 | 32 | 7 | 4 | 158.60 |
| | 21-25 | 30,195 | 2,746 | 3,328 | 82.50 |
| | 26-30 | 182,662 | 11,908 | 14,929 | 79.77 |
| | 31-35 | 428,419 | 20,419 | 25,215 | 80.98 |
| | 36-40 | 730,798 | 25,844 | 29,112 | 88.77 |
| | 41-45 | 1,146,951 | 25,518 | 33,924 | 75.22 |
| | 46-50 | 1,572,347 | 37,563 | 42,807 | 87.75 |
| | 51-55 | 1,323,566 | 38,326 | 42,059 | 91.12 |
| | 56-60 | 450,952 | 15,424 | 18,197 | 84.76 |
| | 61-65 | 2,772 | 270 | 106 | 254.14 |
| | 66-70 | 1,088 | 100 | 0 | n/a |
| | 71-75 | 317 | 64 | 0 | n/a |
| | TOTAL | 5,870,099 | 178,190 | 209,682 | 84.98 |
| **FEMALE** | 16-20 | 15 | 6 | 3 | 210.49 |
| | 21-25 | 8,003 | 1,023 | 1,257 | 81.40 |
| | 26-30 | 64,510 | 7,256 | 7,917 | 91.65 |
| | 31-35 | 174,663 | 13,110 | 15,284 | 85.78 |
| | 36-40 | 409,748 | 21,288 | 25,053 | 84.97 |
| | 41-45 | 735,593 | 30,843 | 33,298 | 92.63 |
| | 46-50 | 1,207,320 | 42,127 | 46,660 | 90.29 |
| | 51-55 | 1,466,529 | 52,417 | 58,878 | 89.03 |
| | 56-60 | 658,208 | 22,559 | 31,080 | 72.58 |
| | 61-65 | 2,772 | 256 | 126 | 204.07 |
| | 66-70 | 727 | 120 | 0 | n/a |
| | 71-75 | 155 | 25 | 0 | n/a |
| | TOTAL | 4,728,243 | 191,032 | 219,555 | 87.01 |
| **TOTAL** | 16-20 | 46 | 13 | 7 | 179.08 |
| | 21-25 | 38,198 | 3,769 | 4,585 | 82.20 |
| | 26-30 | 247,172 | 19,164 | 22,846 | 83.88 |
| | 31-35 | 603,083 | 33,530 | 40,499 | 82.79 |
| | 36-40 | 1,140,546 | 47,132 | 54,165 | 87.02 |
| | 41-45 | 1,882,544 | 56,361 | 67,222 | 83.84 |
| | 46-50 | 2,779,667 | 79,691 | 89,467 | 89.07 |
| | 51-55 | 2,790,095 | 90,742 | 100,936 | 89.90 |
| | 56-60 | 1,109,160 | 37,983 | 49,277 | 77.08 |
| | 61-65 | 5,544 | 526 | 232 | 227.02 |
| | 66-70 | 1,815 | 220 | 0 | n/a |
| | 71-75 | 472 | 90 | 0 | n/a |
| | TOTAL | 10,598,342 | 369,222 | 429,237 | 86.02 |

# Demographic Assumptions (Continued)

## Recommendation for Turnover

The economy since 2008 (covering the last three study periods) has experienced a difficult and unusual period of economic recession followed by a strong recovery which likely influenced participant behavior. In particular, the "ultimate withdrawal" experience was generally lower than expected in the 2012 study (which is normal for an economic recession), then higher than expected in the 2016 study (which is normal for an economic recovery), and now has returned to a level that is between those two lower and higher periods.

Withdrawal rates can often cycle through periods of higher and lower turnover that revert in the next cycle. In such cases, the long-term assumption should not be based solely on either cycle. Based on the current experience and the experience from the last two studies (covering the experience since 2008), the following adjustments are recommended:

| | **Recommended** |
|---|---|
| Teachers | Adjust 1st year withdrawal rates by 90% |
| State Employees | Adjust ultimate withdrawal rates by 110% |
| Political Subdivisions | Adjust 1st year withdrawal rates by 96%<br>Adjust 2nd year withdrawal rates by 90% |

# Demographic Assumptions (Continued)

## Spread of Retirement Ages

Spreads of actual retirement ages have been obtained separately for males and females within each category. Comparisons were also made between the age at which each individual became eligible for full retirement benefits and the age at which he actually retired.

These rates reflect the way in which they are applied. Retirement rates apply to ages that are calculated as the "age nearest birthday" on a valuation date (June 30), and anticipate all retirements before the next June 30. Thus, anyone who attains age 64 during 2015 (i.e., was born in 1951) will be treated as being age 64 in the 2015 valuation. Any member in this group who retires before June 30, 2016 will be thought of, for valuation purposes, as retiring at age 64, even though (for example, a teacher who retires at the end of the 2019-2020 school year) he may already have attained age 65 when he retires. The effect of this approach is to divide between age 64 and age 65 retirements which actually occur shortly after the participants' 65th birthdays, rather than assigning them all to age 65.

As a result of the 2000 study, retirement arrays for each major group were modified to reflect liability weighted patterns. Prior to age 60, retirement rates upon first attaining the service retirement age were increased by 10% for all groups. On and after age 60, retirement rates for participants who have completed at least fifteen years of service were increased by 10%, 5% and 5% for Teachers, State and Political Subdivision employees.

For the 2000 to 2004 study period, the actual to expected ratios for service retirements declined considerably for each major group (all groups had ratios at or near 80%). These results suggested a significant decline in the number of retirements from the results of the 2000 study. Since the observed shift in retirement experience was significant, it was difficult to predict whether the data represented a permanent shift in retirement patterns or only a temporary change due to other factors. The 2004 study recommended that only a portion of the decline in service retirements be reflected in the modified retirement arrays. Retirement patterns from the 1996 to 2000 study period were blended with the results from the 2000 to 2004 study period to produce modified retirement arrays. The expectation was to monitor results over the next study period and adjust again in 2008 if the shift in service retirement was observed again. The 2004 study also modified the special adjustments for retirement rates (prior to age 60 and on or after age 60 with fifteen years of service).

The 2008 analysis continued to suggest that adding an incremental percentage to retirement rates upon attaining the service retirement age prior to age 60 is appropriate. It also supported applying a greater probability of retirement on and after age 60 if the period of employment has been substantial. The extent of the additional retirement probability following attainment of age 60 varies among groups as well as by age and was updated accordingly.

For the 2004 to 2008 study period, the trend for employees to delay retirement continued for all groups. Retirement arrays for each group were modified to reflect the continued change in the pattern of retirement first noticed in the 2004 study. Retirement experience observed during the 2008 study for State employees was adjusted when creating the new assumptions due to an incentive program that was to be effective after the end of the study period. The incentive program was believed to have caused some State employees to delay retirement to take advantage of the incentive program.

# Demographic Assumptions (Continued)

The economy since 2008 has experienced a difficult and unusual period of economic recession followed by a recovery which likely influenced participant behavior. As such, the retirement experience during this period may not be credible for long-term future predictions. No change was made to the retirement assumption in the 2012 study.

Experience observed during the 2016-2020 period is reported on the following pages.

# Demographic Assumptions (Continued)

*Teachers*
*Service Retirement*
*Old Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 16-20 | 0 | 0 | 0 | n/a |
| | 21-25 | 0 | 0 | 0 | n/a |
| | 26-30 | 0 | 0 | 0 | n/a |
| | 31-35 | 0 | 0 | 0 | n/a |
| | 36-40 | 0 | 0 | 0 | n/a |
| | 41-45 | 0 | 0 | 0 | n/a |
| | 46-50 | 171 | 0 | 11 | 0.00 |
| | 51-55 | 208,452 | 24,564 | 31,323 | 78.42 |
| | 56-60 | 728,145 | 85,690 | 126,269 | 67.86 |
| | 61-65 | 899,634 | 188,737 | 249,872 | 75.53 |
| | 66-70 | 228,008 | 65,638 | 52,914 | 124.05 |
| | 71-75 | 49,210 | 13,531 | 13,831 | 97.83 |
| | TOTAL | 2,113,620 | 378,160 | 474,220 | 79.74 |
| **FEMALE** | 16-20 | 0 | 0 | 0 | n/a |
| | 21-25 | 0 | 0 | 0 | n/a |
| | 26-30 | 0 | 0 | 0 | n/a |
| | 31-35 | 0 | 0 | 0 | n/a |
| | 36-40 | 0 | 0 | 0 | n/a |
| | 41-45 | 0 | 0 | 0 | n/a |
| | 46-50 | 1,065 | 170 | 202 | 84.10 |
| | 51-55 | 919,210 | 120,862 | 137,862 | 87.67 |
| | 56-60 | 2,547,766 | 364,477 | 481,564 | 75.69 |
| | 61-65 | 3,109,764 | 719,905 | 982,449 | 73.28 |
| | 66-70 | 810,080 | 218,485 | 263,656 | 82.87 |
| | 71-75 | 121,037 | 24,241 | 60,709 | 39.93 |
| | TOTAL | 7,508,922 | 1,448,140 | 1,926,442 | 75.17 |
| **TOTAL** | 16-20 | 0 | 0 | 0 | n/a |
| | 21-25 | 0 | 0 | 0 | n/a |
| | 26-30 | 0 | 0 | 0 | n/a |
| | 31-35 | 0 | 0 | 0 | n/a |
| | 36-40 | 0 | 0 | 0 | n/a |
| | 41-45 | 0 | 0 | 0 | n/a |
| | 46-50 | 1,236 | 170 | 213 | 79.89 |
| | 51-55 | 1,127,662 | 145,426 | 169,185 | 85.96 |
| | 56-60 | 3,275,911 | 450,167 | 607,833 | 74.06 |
| | 61-65 | 4,009,399 | 908,641 | 1,232,320 | 73.73 |
| | 66-70 | 1,038,088 | 284,123 | 316,570 | 89.75 |
| | 71-75 | 170,247 | 37,772 | 74,540 | 50.67 |
| | TOTAL | 9,622,542 | 1,826,301 | 2,400,662 | 76.07 |

# Demographic Assumptions (Continued)

*General State*
*Service Retirement*
*Old Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 16-20 | 0 | 0 | 0 | n/a |
| | 21-25 | 0 | 0 | 0 | n/a |
| | 26-30 | 0 | 0 | 0 | n/a |
| | 31-35 | 0 | 0 | 0 | n/a |
| | 36-40 | 0 | 0 | 0 | n/a |
| | 41-45 | 0 | 0 | 0 | n/a |
| | 46-50 | 29,883 | 3,445 | 2,399 | 143.61 |
| | 51-55 | 472,901 | 47,511 | 34,356 | 138.29 |
| | 56-60 | 1,066,018 | 138,045 | 95,205 | 145.00 |
| | 61-65 | 1,586,588 | 246,447 | 263,868 | 93.40 |
| | 66-70 | 795,210 | 144,673 | 136,825 | 105.74 |
| | 71-75 | 236,527 | 38,398 | 63,535 | 60.44 |
| | TOTAL | 4,187,127 | 618,518 | 596,187 | 103.75 |
| **FEMALE** | 16-20 | 0 | 0 | 0 | n/a |
| | 21-25 | 0 | 0 | 0 | n/a |
| | 26-30 | 0 | 0 | 0 | n/a |
| | 31-35 | 0 | 0 | 0 | n/a |
| | 36-40 | 0 | 0 | 0 | n/a |
| | 41-45 | 0 | 0 | 0 | n/a |
| | 46-50 | 35,929 | 6,033 | 3,650 | 165.29 |
| | 51-55 | 601,352 | 68,622 | 55,859 | 122.85 |
| | 56-60 | 1,577,912 | 165,970 | 150,199 | 110.50 |
| | 61-65 | 2,238,107 | 368,635 | 380,623 | 96.85 |
| | 66-70 | 792,874 | 180,816 | 148,775 | 121.54 |
| | 71-75 | 183,242 | 40,778 | 48,079 | 84.81 |
| | TOTAL | 5,429,416 | 830,854 | 787,185 | 105.55 |
| **TOTAL** | 16-20 | 0 | 0 | 0 | n/a |
| | 21-25 | 0 | 0 | 0 | n/a |
| | 26-30 | 0 | 0 | 0 | n/a |
| | 31-35 | 0 | 0 | 0 | n/a |
| | 36-40 | 0 | 0 | 0 | n/a |
| | 41-45 | 0 | 0 | 0 | n/a |
| | 46-50 | 65,812 | 9,478 | 6,049 | 156.69 |
| | 51-55 | 1,074,254 | 116,133 | 90,214 | 128.73 |
| | 56-60 | 2,643,929 | 304,015 | 245,404 | 123.88 |
| | 61-65 | 3,824,695 | 615,082 | 644,491 | 95.44 |
| | 66-70 | 1,588,084 | 325,489 | 285,600 | 113.97 |
| | 71-75 | 419,770 | 79,176 | 111,615 | 70.94 |
| | TOTAL | 9,616,544 | 1,449,373 | 1,383,372 | 104.77 |

# Demographic Assumptions (Continued)

*Political Subdivisions*
*Service Retirement*
*Old Assumptions*

| | | *Exposure* | *Actual* | *Expected* | *Act/Exp* |
|---|---|---|---|---|---|
| **MALE** | 16-20 | 0 | 0 | 0 | n/a |
| | 21-25 | 0 | 0 | 0 | n/a |
| | 26-30 | 0 | 0 | 0 | n/a |
| | 31-35 | 0 | 0 | 0 | n/a |
| | 36-40 | 0 | 0 | 0 | n/a |
| | 41-45 | 0 | 0 | 0 | n/a |
| | 46-50 | 46,739 | 5,557 | 4,436 | 125.26 |
| | 51-55 | 399,946 | 47,541 | 45,681 | 104.07 |
| | 56-60 | 863,403 | 90,303 | 96,314 | 93.76 |
| | 61-65 | 1,268,536 | 206,873 | 253,954 | 81.46 |
| | 66-70 | 393,074 | 88,715 | 73,715 | 120.35 |
| | 71-75 | 148,671 | 21,533 | 47,113 | 45.70 |
| | TOTAL | 3,120,369 | 460,522 | 521,213 | 88.36 |
| **FEMALE** | 16-20 | 0 | 0 | 0 | n/a |
| | 21-25 | 0 | 0 | 0 | n/a |
| | 26-30 | 0 | 0 | 0 | n/a |
| | 31-35 | 0 | 0 | 0 | n/a |
| | 36-40 | 0 | 0 | 0 | n/a |
| | 41-45 | 0 | 0 | 0 | n/a |
| | 46-50 | 18,128 | 438 | 1,488 | 29.44 |
| | 51-55 | 177,770 | 13,505 | 17,886 | 75.51 |
| | 56-60 | 707,494 | 58,657 | 85,459 | 68.64 |
| | 61-65 | 1,544,255 | 237,297 | 281,807 | 84.21 |
| | 66-70 | 536,466 | 108,181 | 111,108 | 97.37 |
| | 71-75 | 184,106 | 31,077 | 59,286 | 52.42 |
| | TOTAL | 3,168,219 | 449,155 | 557,033 | 80.63 |
| **TOTAL** | 16-20 | 0 | 0 | 0 | n/a |
| | 21-25 | 0 | 0 | 0 | n/a |
| | 26-30 | 0 | 0 | 0 | n/a |
| | 31-35 | 0 | 0 | 0 | n/a |
| | 36-40 | 0 | 0 | 0 | n/a |
| | 41-45 | 0 | 0 | 0 | n/a |
| | 46-50 | 64,866 | 5,995 | 5,925 | 101.19 |
| | 51-55 | 577,716 | 61,046 | 63,567 | 96.03 |
| | 56-60 | 1,570,897 | 148,959 | 181,772 | 81.95 |
| | 61-65 | 2,812,792 | 444,170 | 535,761 | 82.90 |
| | 66-70 | 929,540 | 196,896 | 184,823 | 106.53 |
| | 71-75 | 332,777 | 52,610 | 106,399 | 49.45 |
| | TOTAL | 6,288,588 | 909,677 | 1,078,246 | 84.37 |

# Demographic Assumptions (Continued)

## Recommendation for Retirement Ages

The economy since 2008 (covering the last three study periods) has experienced a difficult and unusual period of economic recession followed by a strong recovery which likely influenced participant behavior. In particular, the retirement experience was generally lower than expected in the 2012 study (which is normal for an economic recession), then higher than expected in the 2016 study (which is normal for an economic recovery), and now has reverted to a lower level of retirements than the 2016 study (and lower than the assumed experience for the Teachers and Political Subdivisions).

Retirement rates can often cycle through periods of higher and lower experience that revert in the next cycle. In such cases, the long-term assumption should not be based solely on either cycle. Based on the current experience and the experience from the last two studies (covering the experience since 2008), the following adjustments are recommended:

| | **Recommended** |
|---|---|
| Teachers | 1. Adjust additional increment for retirees who have 15+ years of service on or after age 60 from 8.0% to 7.0% |
| State Employees | 1. Adjust additional increment for 1st year of eligibility prior to age 60 from 7.5% to 9.0%<br>2. Adjust additional increment for retirees who have 15+ years of service on or after age 60 from 2.0% to 3.0% |
| Political Subdivisions | 1. Adjust additional increment for 1st year of eligibility prior to age 60 from 7.5% to 6.5%<br>2. Adjust additional increment for retirees who have 15+ years of service on or after age 60 from 2.0% to 3.0% |

# Demographic Assumptions (Continued)

## Summary of Demographic Assumptions

Recommendations of demographic assumptions utilized for each major group have been made herein. These changes relate to experience identified (when deemed to be credible) from the four year period ending June 30, 2020. It is recommended that the revised array of assumptions be adopted for the major groups of employees.

# Economic Assumptions

Various economic assumptions such as interest rates, probable future salary increases, and increases in the Social Security taxable wage base are all linked to general economic conditions (especially the rate of inflation), and therefore are interrelated. Economic assumptions are not so directly the province of the actuary as are the assumptions previously discussed. Nevertheless, assumptions concerning the future pattern of these items are more important in determining plan costs than any of the decrements previously discussed, and usually are included under the title "Actuarial Assumptions." Also, past performance can serve as a clue to future performance, even if only as a starting point for adjustments reflecting changed situations.

Economic assumptions are often determined based upon a component approach. Under this approach, the individual elements of each assumption are identified and combined to produce a total or composite amount. Each of these components contains inflation as a common item.

## Inflation

Inflation is a common element in each of the economic assumptions made for the plan. Inflation is also a separate assumption that affects costs by determining cost of living adjustments that affect geometrically increased plan benefits following retirement.

There has been substantial fluctuation in historical rates of inflation. The table below presents rates of inflation that have occurred over various periods ending in 2020.

| ***Period*** | ***Period Length*** | ***Inflation*** |
|---|---|---|
| 2020-2020 | 1 | 1.4% |
| 2006-2020 | 15 | 1.9% |
| 1996-2020 | 25 | 2.1% |
| 1991-2020 | 30 | 2.3% |
| 1971-2020 | 50 | 3.8% |
| 1961-2020 | 60 | 3.7% |
| 1946-2020 | 75 | 3.6% |
| 1941-2020 | 80 | 3.7% |

Indicators of future inflation expectations include the opinion of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds, whose 2021 Annual Report discusses underlying actuarial assumption data. The report provides sets of low, intermediate and high cost actuarial assumptions. The ultimate annual inflation assumption documented in the report is assumed to be 1.8%, 2.4% and 3.0% for the low, intermediate and high cost assumptions, respectively.

## Recommendation for Inflation

Based upon the above historical information and expectation of future occurrences, the expected annual rate of inflation has been established at an intermediate annual rate of 2.25%. This expected annual rate of future inflation is a decrease from the current assumption being used by TCRS of 2.50%.

# Economic Assumptions (Continued)

## Cost of Living Adjustment for TCRS Retirees

TCRS provides an annual cost of living adjustment to retirees effective July 1 of each year based on the inflation measured in the previous calendar year. The method for determining the cost of living adjustment does not allow the adjustment to exceed 3.0% in any given year. The table below is the same as the one shown in the inflation section above that presents rates of inflation that have occurred over various periods ending in 2020, but this table contains an extra column to show the impact of applying the 3.0% limit over each period.

| ***Period*** | ***Period Length*** | ***Inflation*** | ***3.0% Limit Per Year*** |
|---|---|---|---|
| 2020-2020 | 1 | 1.4% | 1.4% |
| 2006-2020 | 15 | 1.9% | 1.8% |
| 1996-2020 | 25 | 2.1% | 2.0% |
| 1991-2020 | 30 | 2.3% | 2.2% |
| 1971-2020 | 50 | 3.8% | 2.5% |
| 1961-2020 | 60 | 3.7% | 2.4% |
| 1946-2020 | 75 | 3.6% | 2.3% |
| 1941-2020 | 80 | 3.7% | 2.3% |

The expected annual rate of inflation was established in the previous section at 2.25%. This assumption does not imply that inflation will be exactly 2.25% in each future year, but rather that inflation will average 2.25% in the future (some years greater and some years less). During periods when actual inflation is high, the TCRS cost of living adjustment will be limited to 3.0%. Therefore, the range of future TCRS cost of living adjustments will be between the actual rate of inflation during low inflationary periods and 3.0%.

## Recommendation for Cost of Living Adjustment

Based upon the above historical information and the assumption that the long-term average expectation of future inflation has been established at 2.25%, the expected rate of the cost of living adjustment to TCRS retirees has been established at an annual rate of 2.125%. This expected annual rate of the cost of living adjustment is a decrease from the current assumption being used by TCRS of 2.25%.

# Economic Assumptions (Continued)

## Interest Rates

The long-term rate of return on investments is the most important single factor in determining the cost of a pension plan with a given set of benefits and participants. The investment experience of the TCRS trust fund has been studied on a "total return" basis by the TCRS investment staff. The following table shows the historical investment return for each individual year and the 30-year average annualized rates of return through the given year:

| Fiscal Year | Rate of Return During Year | 30-Year Average Annualized Rate of Return Through Given Year |
|---|---|---|
| 2020-2021 | 25.6% | 8.07% |
| 2019-2020 | 4.9 | 7.52 |
| 2018-2019 | 7.5 | 7.74 |
| 2017-2018 | 8.2 | 7.99 |
| 2016-2017 | 11.4 | 7.78 |
| 2015-2016 | 2.8 | 7.74 |
| 2014-2015 | 3.3 | 8.53 |
| 2013-2014 | 16.7 | 9.32 |
| 2012-2013 | 9.9 | 8.64 |
| 2011-2012 | 5.6 | 9.40 |

From the table above, it may be seen that the 30-year average annual total rate of return through 2021 is 8.07%, but within that period there has been substantial fluctuation. Adjusting the results to reflect the assumed inflation rate of 2.25%, lowers 30-year average annual total rate of return through 2021 to 7.99%.

In accordance with investment policies established by the Board, TCRS investments emphasize bonds and other fixed income securities, but also include a substantial percentage of equity investments. On a "total return" basis, both kinds of investments are subject to wide fluctuations dependent upon market and economic conditions. The results shown in the table illustrate such fluctuations.

In order to arrive at contribution rates that are not unduly affected by these fluctuations, TCRS valuations assign a value to assets which is based on a "10-year moving average of market values". Over a short period, this approach may differ substantially from the year-by-year results shown above, but over longer periods the results should be similar and should reasonably replicate market value results. The smoothing process attempts to avoid the wide fluctuations shown in the table, tending also to smooth contribution rates.

# Economic Assumptions (Continued)

Any analysis of expected returns should include both long-term historical returns and current expectations of the future investment climate. Generally, current expectations are useful for predicting short-term returns, while historical experience can be a better indicator of longer-term expected returns. However, it should be noted that the economic environment may have changed to be significantly different than the past historical values.

An expected long-term rate of return for the plan has been developed using a blend of future expectations of returns and long-term historical performance. The following chart reflects the investment policy adopted by the Board. The policy permits investments from various asset classes within a minimum and maximum allocation percentage, and also defines a target portfolio to determine the basis for measuring investment performance of the fund. Since the investment manager will make decisions to periodically over or under weight a particular asset class, the basis used for estimating future returns is the target portfolio instead of the plan's actual asset allocation at any given point in time.

**TCRS Investment Policy**

| Asset Class | Minimum | Maximum | Target |
|---|---|---|---|
| Domestic Stocks | 25% | 50% | 31% |
| Domestic Bonds | 0% | 60% | 20% |
| Inflation Indexed Bonds | 0% | 15% | 0% |
| Short-term Securities | 0% | 10% | 1% |
| International Bonds | 0% | 10% | 0% |
| International Stocks | 5% | 25% | 14% |
| Emerging Markets Stocks* | 0% | 10% | 4% |
| Private Equity & Strategic Lending | 0% | 40% | 20% |
| Real Estate | 0% | 20% | 10% |

*Emerging Market Stocks are a subset of International Stocks; Maximum International Stocks and Emerging Market Stocks may not exceed 25%.

**Future Expectations of Returns**

For each asset class, we have used the long-term average expected real return from the 2021 Horizon Survey of Capital Market Assumptions. This survey includes assumptions from 24 different investment firms for a 20-year horizon. The expected real return for each asset class is multiplied by the target allocation to determine the weighted-average real return for the entire portfolio as shown below (asset classes with a target allocation of 0% are excluded):

# Economic Assumptions (Continued)

| Asset Class | Expected Real Return | Target Allocation | Weighted Average Real Return |
|---|---|---|---|
| Domestic Stocks* | 4.45% | 31% | 1.38% |
| Domestic Bonds | 1.00% | 20% | 0.20% |
| Short-term Securities | 0.00% | 1% | 0.00% |
| International Stocks | 4.91% | 14% | 0.69% |
| Emerging Markets Stocks | 5.58% | 4% | 0.22% |
| Private Equity | 7.42% | 10% | 0.74% |
| Strategic Lending | 4.64% | 10% | 0.46% |
| Real Estate | 3.98% | 10% | 0.40% |
| | | Expected Real Return for Portfolio: | 4.09% |
| | | Recommended Inflation Assumption: | 2.25% |
| | | Expected Total Return for Portfolio: | 6.34% |

*Domestic Stocks are a blend of Large Cap (4.42%) and Small/Mid Cap (4.81%) based on the underlying TCRS weightings between those two subsets of Domestic Stocks.

All returns above are reported without regard to expenses. An explicit expense assumption is incorporated in the actuarial valuation report and contribution rate recommendations to reflect actual expenses.

While there is no single "correct" assumption for the rate of investment return, the range of 6.34% (based on current market forecasts) to 7.99% (based on TCRS historical returns, adjusted to reflect the assumed inflation rate of 2.25%) gives a reasonable range of outcomes that might be expected based on the plan's current funding policy. Based on this analysis, a rate of 6.75% would appear to be a reasonable assumption, which represents a 75% weighting on current market forecasts and a 25% weighting on TCRS historical returns.

## Recommendation for Interest Rate

Based upon the above information, rate of investment return has been established at 6.75%, which is a decrease from the current assumption being used by TCRS of 7.25%. The rate is based upon an inflation rate of 2.25%, which is consistent with the underlying inflation rate used in the establishment of other economic assumptions.

# Economic Assumptions (Continued)

## Salary Scale

In recent years, there has been a tendency away from uniform salary scales that do not vary by age to age graded scales. Age graded scales typically begin with higher increase rates for the younger ages where salary increases are highest and decline to lower levels for older participants where increases often approximate the cost of living. While direct comparisons may be accurately made among plans that use a uniform scale, comparisons between age graded scales are not as easily made. A 5% uniform scale will produce higher contribution rates than an age graded scale that begins at 7% and declines to 3%, for which the *average* is 5%, because the higher rates of the graded scale affect only the relatively smaller number of participants who are below the age midpoint.

After the 2000 experience study, salary assumptions were adopted to include an age-related feature for the first time. The new salary assumptions were further validated with the 2004 study where no changes were recommended. The greater accuracy achieved with age related tables offsets the small advantage of greater understandability afforded by uniform tables.

Under the current tables, salary increases decline from 8.7% at age 20 to 3.5% at age 60. Rates are assumed to decline very modestly thereafter to 3.4% ultimately. The average increase from age 20 to 60 is 5.3%. Although the average seems high, the table in aggregate is actually less conservative than the average because the higher rates applicable to younger employees affect a relatively small group of employees for whom the expectation of reaching retirement and receiving benefit values are low. The graded salary scale replicates the effect of a uniform salary scale that increases annually at the rate of approximately 4.0%.

The current experience period shows average salary increases to be higher than expected based on the current assumptions. Average salaries for all groups averaged around 2.6% during the period 2008 to 2012, around 3.5% during the period 2012 to 2016, and around 4.8% during the period 2016 to 2020. Based on the experience over the last three study periods (which included both a recession and a recovery), the salary increases have fluctuated above and below the current assumption.

The tables show that salary increases continue to vary significantly by age among all major groups. This result further supports the continued use of an age graded salary scale. There is also variability by year of examination. Further, the average percentage increase was 5.97% for the State group over the period 2016 to 2020 (which is believed to be a direct result of some short-term compensation policies and adjustments).

# Economic Assumptions (Continued)

## Recommendation for Salary Scale

The average salary growth for 2016 to 2020 was above the current assumption of approximately 4.0%, while the average experience in the two previous studies was below 4.0%. Further, TCRS indicated that continued market pressure is expected to limit compensation increases in the future. The current 4.0% assumption is comprised of a 2.5% general inflation assumption, plus a 0.5% national productivity (real wage) assumption, plus a 1.0% merit increase assumption. To better reflect future expectations, it is recommended that the merit increase assumption be increased 25 basis points. Since the general inflation assumption has been reduced by 25 basis points (from 2.5% to 2.25%), the net effect is no change in the total salary growth assumption.

*Teachers*
*Salary History - Individual Records*
*Weighted By Salary*

| | | | Percentage Increase in Average Salary | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2016 No. | 2016-17 | 2017-18 | 2018-19 | 2019-20 | Average | Exp. Inc. |
| **TOTAL** | 16-20 | 1 | 16.29 | 0.00 | 0.00 | 0.00 | 16.29 | 9.21 |
| | 21-25 | 407 | 7.23 | 7.74 | 3.77 | 6.08 | 6.14 | 7.98 |
| | 26-30 | 6,181 | 5.23 | 7.30 | 3.03 | 5.81 | 5.35 | 6.79 |
| | 31-35 | 8,189 | 5.14 | 7.31 | 2.60 | 6.02 | 5.27 | 6.03 |
| | 36-40 | 9,609 | 4.88 | 7.15 | 2.28 | 5.31 | 4.90 | 5.36 |
| | 41-45 | 10,357 | 4.24 | 6.57 | 1.97 | 4.72 | 4.37 | 4.71 |
| | 46-50 | 10,212 | 3.83 | 6.01 | 1.57 | 4.08 | 3.85 | 4.16 |
| | 51-55 | 7,168 | 3.36 | 5.77 | 1.16 | 3.82 | 3.49 | 3.81 |
| | 56-60 | 5,735 | 3.12 | 5.34 | 1.01 | 3.59 | 3.27 | 3.58 |
| | 61-65 | 2,773 | 2.79 | 5.12 | 0.91 | 3.34 | 3.04 | 3.46 |
| | 66-70 | 669 | 2.85 | 4.62 | 1.57 | 2.98 | 2.99 | 3.44 |
| | 71-75 | 111 | 2.21 | 3.55 | 1.22 | 2.82 | 2.46 | 3.43 |
| | TOTAL | 61,412 | 4.14 | 6.37 | 1.84 | 4.57 | 4.22 | |

# Economic Assumptions (Continued)

*General Employees*
*Salary History - Individual Records*
*Weighted By Salary*

| | | | Percentage Increase in Average Salary | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2016 No. | 2016-17 | 2017-18 | 2018-19 | 2019-20 | Average | Exp. Inc. |
| **TOTAL** | 16-20 | 1 | 16.81 | 0.00 | 0.00 | 23.28 | 19.70 | 9.21 |
| | 21-25 | 311 | 11.28 | 11.09 | 8.33 | 12.47 | 10.81 | 7.98 |
| | 26-30 | 2,389 | 10.30 | 9.62 | 7.59 | 9.35 | 9.17 | 6.79 |
| | 31-35 | 3,442 | 9.24 | 8.15 | 6.92 | 8.37 | 8.13 | 6.03 |
| | 36-40 | 4,435 | 8.11 | 7.22 | 6.11 | 7.44 | 7.19 | 5.36 |
| | 41-45 | 5,096 | 7.23 | 6.62 | 5.67 | 6.48 | 6.47 | 4.71 |
| | 46-50 | 5,901 | 6.40 | 5.86 | 4.93 | 6.09 | 5.81 | 4.16 |
| | 51-55 | 6,705 | 6.20 | 5.51 | 4.69 | 5.66 | 5.51 | 3.81 |
| | 56-60 | 6,609 | 5.61 | 5.10 | 4.39 | 5.27 | 5.09 | 3.58 |
| | 61-65 | 4,447 | 4.96 | 4.65 | 3.97 | 4.70 | 4.57 | 3.46 |
| | 66-70 | 1,583 | 4.22 | 3.68 | 3.28 | 4.02 | 3.81 | 3.44 |
| | 71-75 | 467 | 3.92 | 3.94 | 2.99 | 3.37 | 3.51 | 3.43 |
| | TOTAL | 41,386 | 6.61 | 6.04 | 5.13 | 6.17 | 5.97 | |

*Political Subdivisions*
*Salary History - Individual Records*
*Weighted By Salary*

| | | | Percentage Increase in Average Salary | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2016 No. | 2016-17 | 2017-18 | 2018-19 | 2019-20 | Average | Exp. Inc. |
| **TOTAL** | 16-20 | 1 | 44.99 | -4.59 | 6.82 | 9.93 | 11.70 | 9.21 |
| | 21-25 | 713 | 8.16 | 6.88 | 8.21 | 7.78 | 7.76 | 7.98 |
| | 26-30 | 2,699 | 7.07 | 5.37 | 6.67 | 6.36 | 6.36 | 6.79 |
| | 31-35 | 3,927 | 6.11 | 5.10 | 5.77 | 5.62 | 5.65 | 6.03 |
| | 36-40 | 5,311 | 5.67 | 4.76 | 5.28 | 5.16 | 5.21 | 5.36 |
| | 41-45 | 6,834 | 5.34 | 4.38 | 4.76 | 4.81 | 4.82 | 4.71 |
| | 46-50 | 8,883 | 4.96 | 4.04 | 4.49 | 4.58 | 4.52 | 4.16 |
| | 51-55 | 9,483 | 4.49 | 3.93 | 4.40 | 4.16 | 4.24 | 3.81 |
| | 56-60 | 9,062 | 4.42 | 3.76 | 3.92 | 3.78 | 3.96 | 3.58 |
| | 61-65 | 5,814 | 3.90 | 3.44 | 3.84 | 3.33 | 3.61 | 3.46 |
| | 66-70 | 2,141 | 3.89 | 3.46 | 3.80 | 3.24 | 3.56 | 3.44 |
| | 71-75 | 872 | 3.73 | 3.46 | 3.72 | 2.69 | 3.35 | 3.43 |
| | TOTAL | 55,740 | 4.96 | 4.18 | 4.64 | 4.46 | 4.55 | |

# Economic Assumptions (Continued)

## Social Security Increases

Although the TCRS is not heavily integrated with Social Security, it is affected by changes in the Social Security taxable wage base because such changes affect the "Social Security Integration Level" of the TCRS. In general, the State's cost is lowered somewhat by assuming that the taxable wage base will increase. Since such increases are primarily due to inflation, an assumption concerning the wage base should parallel the interest assumption. An appropriate wage base escalation rate that relates consistently to the other economic assumptions can be determined by combining the expected real wage increase rate of 0.5% with anticipated inflation of 2.25% to produce a rate of 2.75%. This rate is a decrease from the current assumption being used by TCRS of 3.0%.

## Summary of Economic Assumptions

The group of economic assumptions recommended above is based upon an integrated set of assumptions of which inflation is common to all. The approach taken in establishing assumptions results in coordination among the assumption elements.

# Other Groups

The thrust of this study has been directed toward three major groups—Teachers, general State employees, and Political Subdivision employees. These three groups include the vast bulk of TCRS participants. Two other small groups ("UT-TIAA with guarantee" and "Local Teachers") are basically teacher groups, so it is recommended that the assumptions adopted for Teachers also be applied to them. The "Aged Teacher and State" retirees also are primarily former teachers, so they also should be covered by the assumptions used for Teachers.

"Group II" is a closed group that is not large enough to have credible experience with respect to mortality or disability. It is proposed that this group adopt the same mortality and disability assumptions as the Consolidated State group. Turnover varies from expected rates, but experience and recent economic experience limits credibility. It is recommended that existing tables continue to be used for turnover.

"Group III" is a closed group that is also not large enough to generate credible experience. It is recommended that the mortality and disability rates adopted for Teachers be used also for "Group III." It is proposed that the retirement array adopted after the 2008 study be maintained without further changes for this group. The current schedule assumes rates of retirement for those who have met the service retirement eligibility requirements of 8% after age 50 increasing to 20% after age 65.